The fair value of unlisted infrastructure investments

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EDHEC_infra_
building benchmarks
for infrastructure investors

Agenda

EDHEC*infra*

I. Infrastructure investment beliefs & taxonomy

1.1 The narrative

- The story: infrastructure companies are steady, **predictable** businesses that benefit from minimal price-elasticity of demand (**monopolistic**) and little exposure to the **business cycle**.
  - ✓ "Essential services"
  - ✓ "Long-term"
  - ✓ "Inflation hedge"
  - ✓ "Real"

- The intuition (investment belief): infrastructure investment creates **diversification** benefits, improves the **risk–return** profile of the portfolio (illiquidity, monopoly rents), and can help in an **ALM** context

- The question: can we find a meaningful evidence of this intuition?

1.2 Is the infrastructure asset class fake? (1)

EDHEC Active Listed Infrastructure Proxy vs MSCI World Index (June 2018)
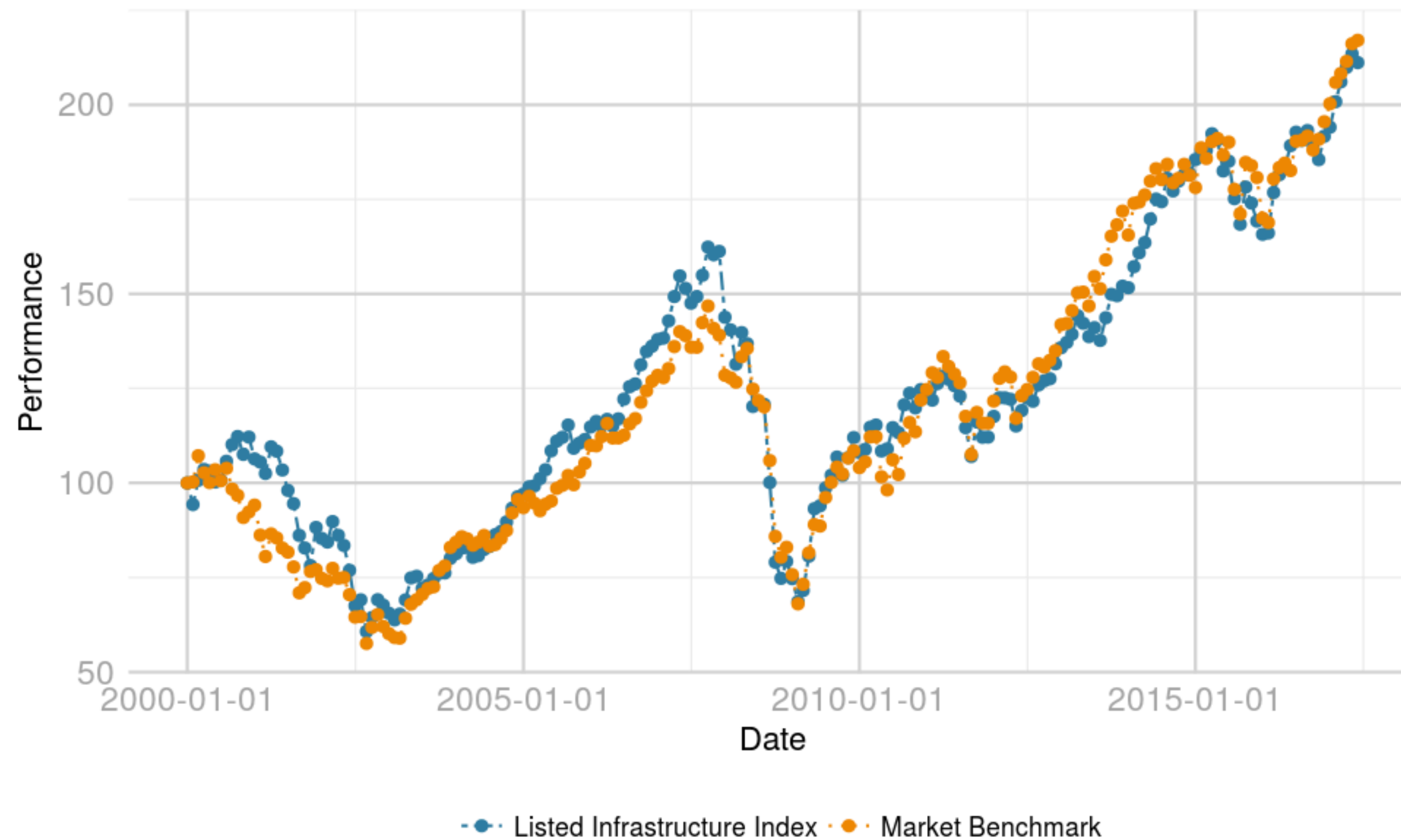
1.2 Is the infrastructure asset class fake? (2)

- We looked at both active (mutual funds) and passive (ETFs) listed infrastructure products: 144 active products, $60bn AUM, ~90% universe and 147 listed infrastructure indices (16 providers)

- We build a **proxy** using *actual* investments but found no asset class...

  - Market beta: 95-98% correlation with the MSCI World Index.

  - Simple factor model explains most of the return variance

  - Same Sharpe ratio, higher or similar drawdown than global markets

  - Mean-variance spanning tests all fail

- Yet the funds' fee are very high compared to other mutual funds

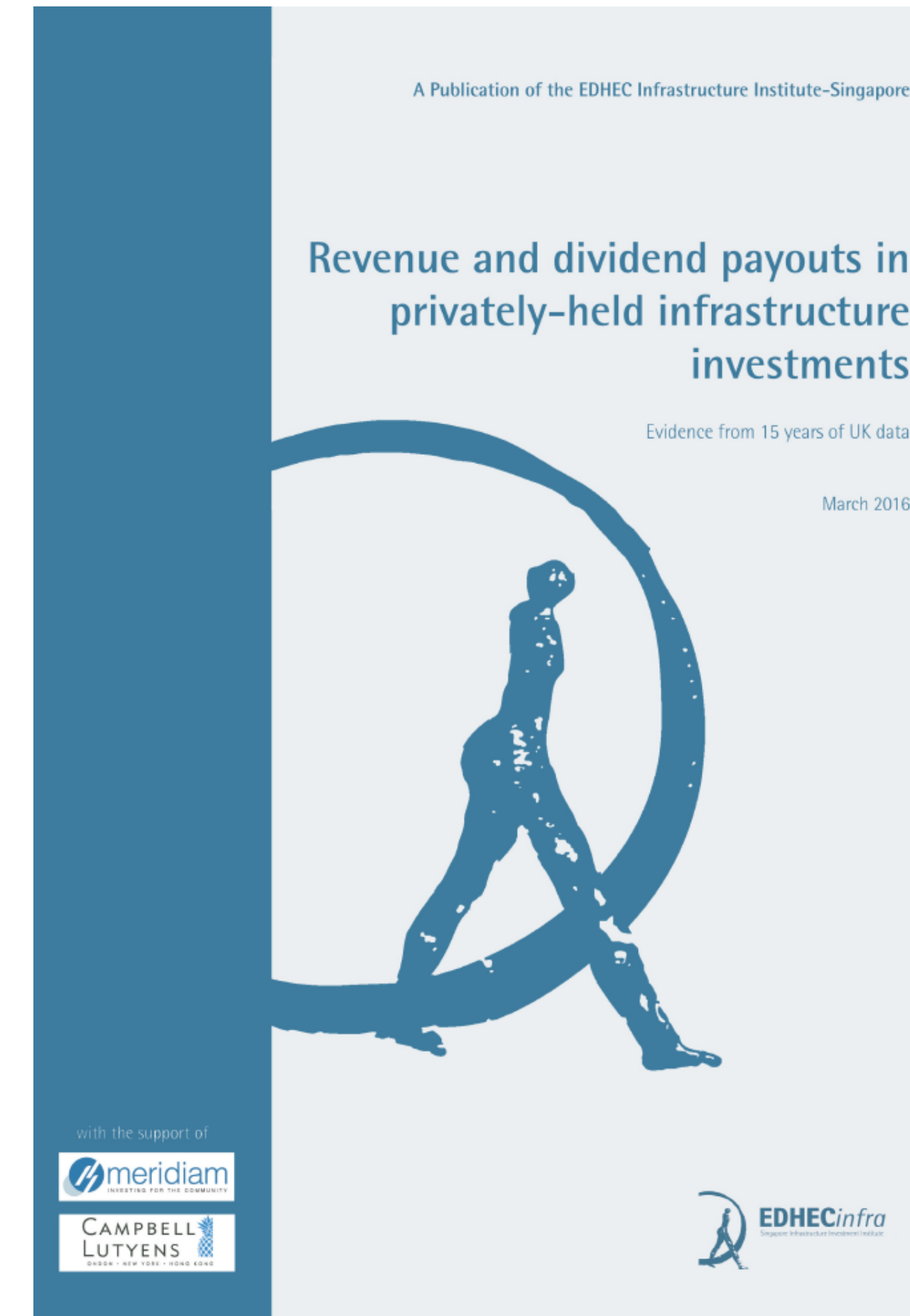# 1.2 Is the infrastructure asset class fake? (3)

- Multiple peer-reviewed studies conducted*

- There are two issues

  - **Definition**: about half of the stocks found in active products are really not 'infrastructure' at all.

  - **Existence**: most unlisted infrastructure investment have no equivalent in listed markets

    ➡ Same tests fail on the 50% of the listed infra universe which could be considered 'infra' (by industry code)

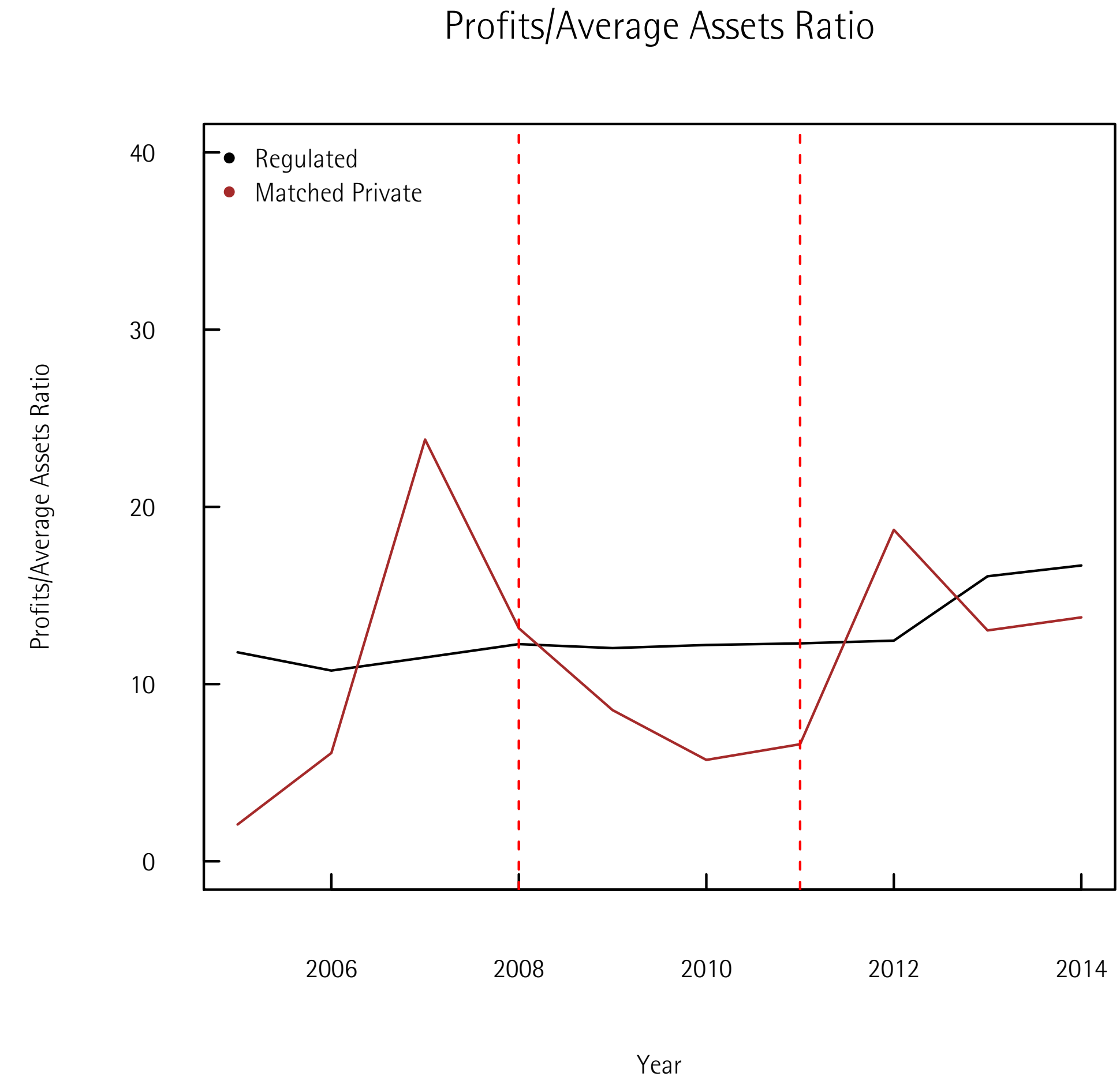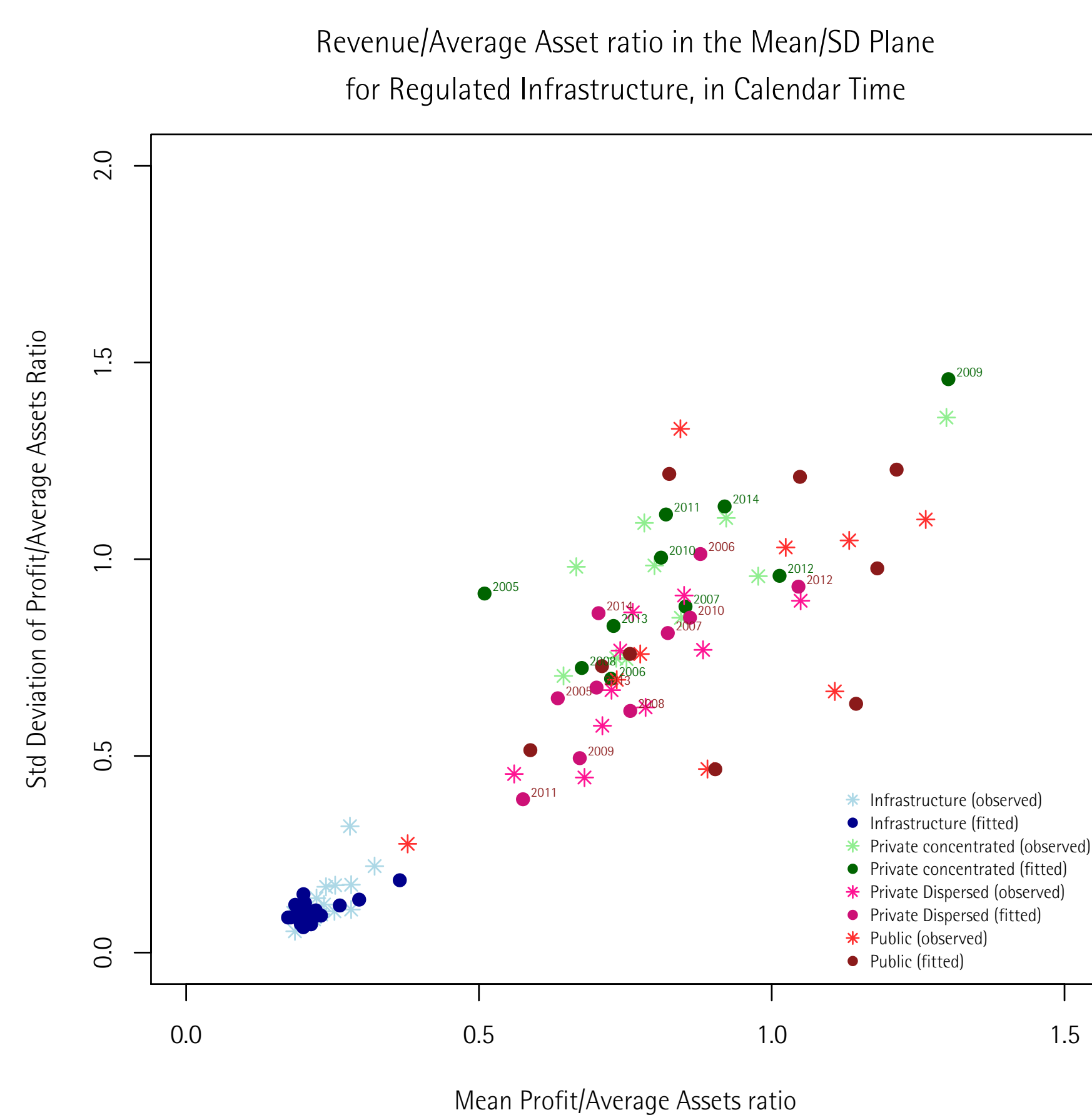- Is it impossible to image *genuine* listed infrastructure?

The Rise of "Fake Infra"

The Unregulated Growth of Listed Infrastructure and the Dangers It Poses to the Future of Infrastructure Investing

October 2017

Noël Amenc
Professor of Finance, EDHEC Business School
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Infrastructure Institute

*Blanc-Brude, F., Whittaker, T., & Wilde, S. (2017). Searching for a listed infrastructure asset class using mean–variance spanning. *Financial Markets and Portfolio Management, 31*(2), 137-179. Bianchi, R., Drew, M., & Whittaker, T. (2017). Is "Listed Infrastructure" a fake asset class? EDHEC Business School Working Paper. Amenc A., Blanc-Brude F., Chreng A. & Tran C. (2018) "The Rise of fake Infra"

1.3 Evidence from the cash flow data of unlisted infrastructure firms (1)

- We looked at the **cash flows of individual private infrastructure companies**: revenues, profits and payouts to equity owners

- We matched them to three equivalent **control groups**: listed companies, unlisted companies with concentrated owners and listed companies with unlisted companies with dispersed owners

- Test for differences using data for a single market

- Compare 330+ unlisted infrastructure UK firms (SPVs or utilities) with thousands of other UK firms

A Publication of the EDHEC Infrastructure Institute-Singapore

Revenue and dividend payouts in privately-held infrastructure investments

Evidence from 15 years of UK data

March 2016

with the support of

meridiam
INVESTING FOR THE COMMUNITY

CAMPBELL
LUTYENS

EDHEC*infra*

1.3 Evidence from the cash flow data of unlisted infrastructure firms (2)

Revenue/Average Asset ratio in the Mean/SD Plane
for Regulated Infrastructure, in Calendar Time

Profits/Average Assets Ratio

- *Similar results for revenues and profits of contracted and merchant firms.*
- *Time series of revenues and profit ratios are uncorrelated with GDP, CPI etc, whereas they are for control groups*
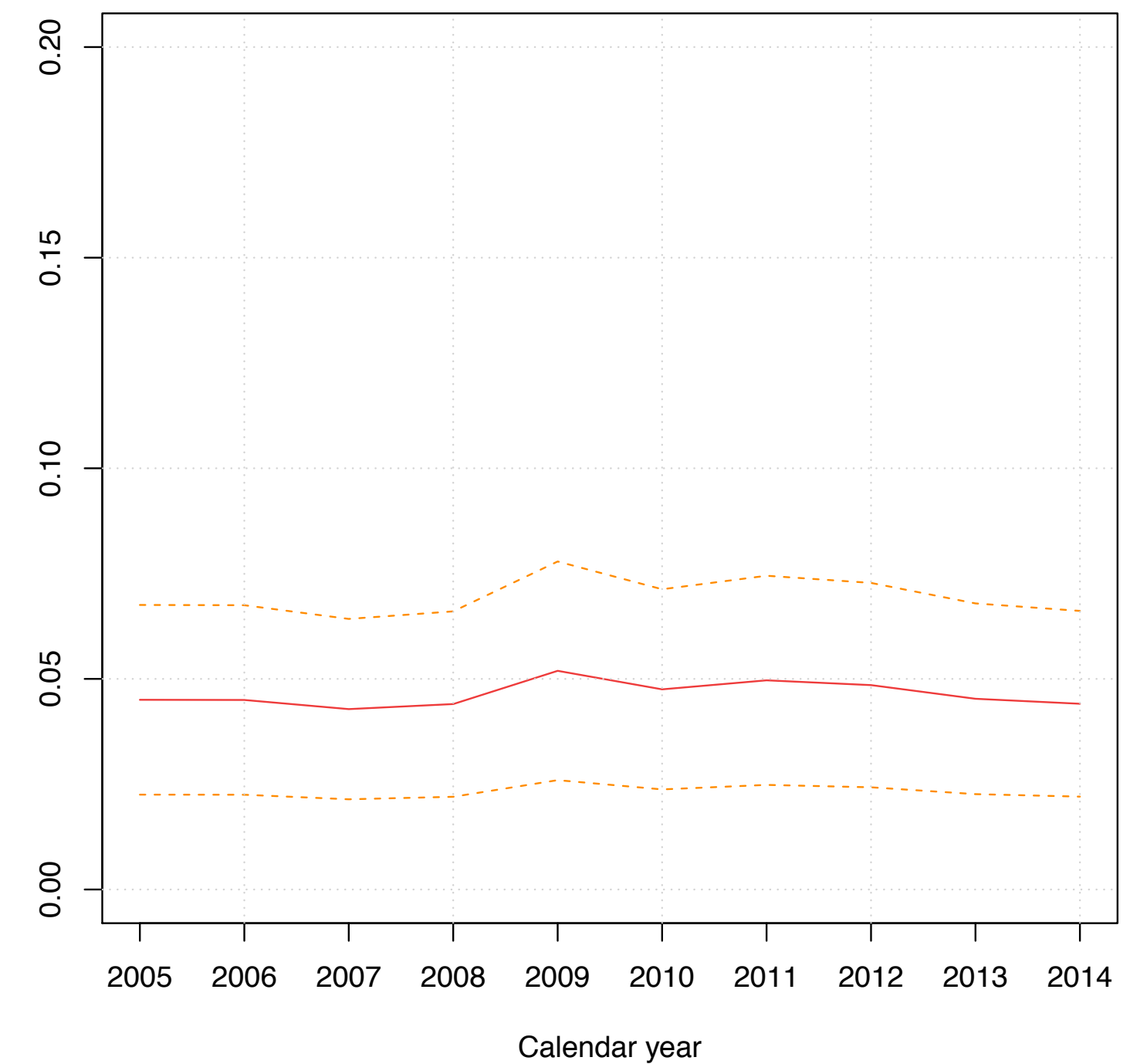
Expected equity payout ratio in contracted infrastructure firms
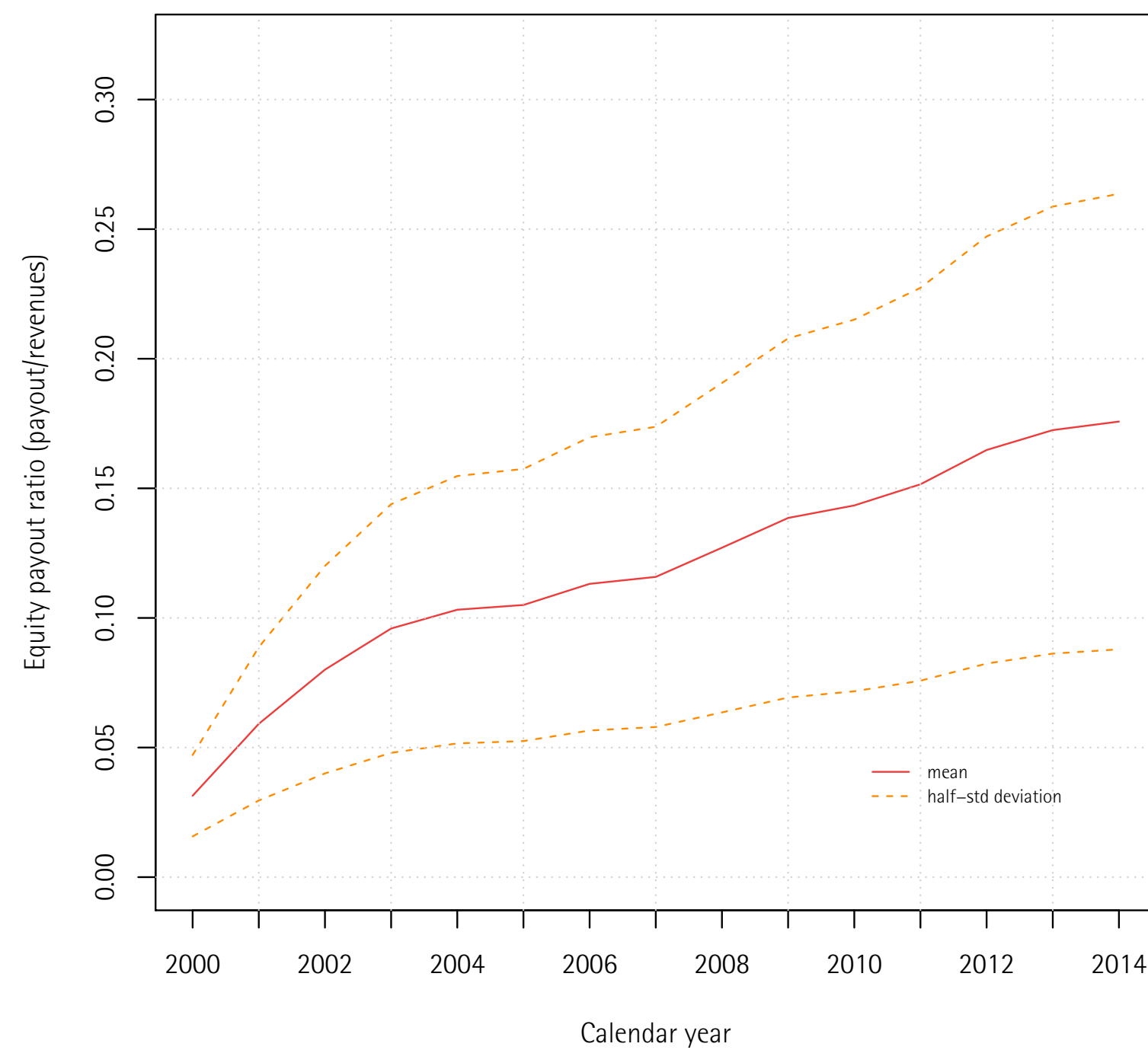
Expected equity payout ratio in private firms (concent. ownership) matched to contracted infrastructure
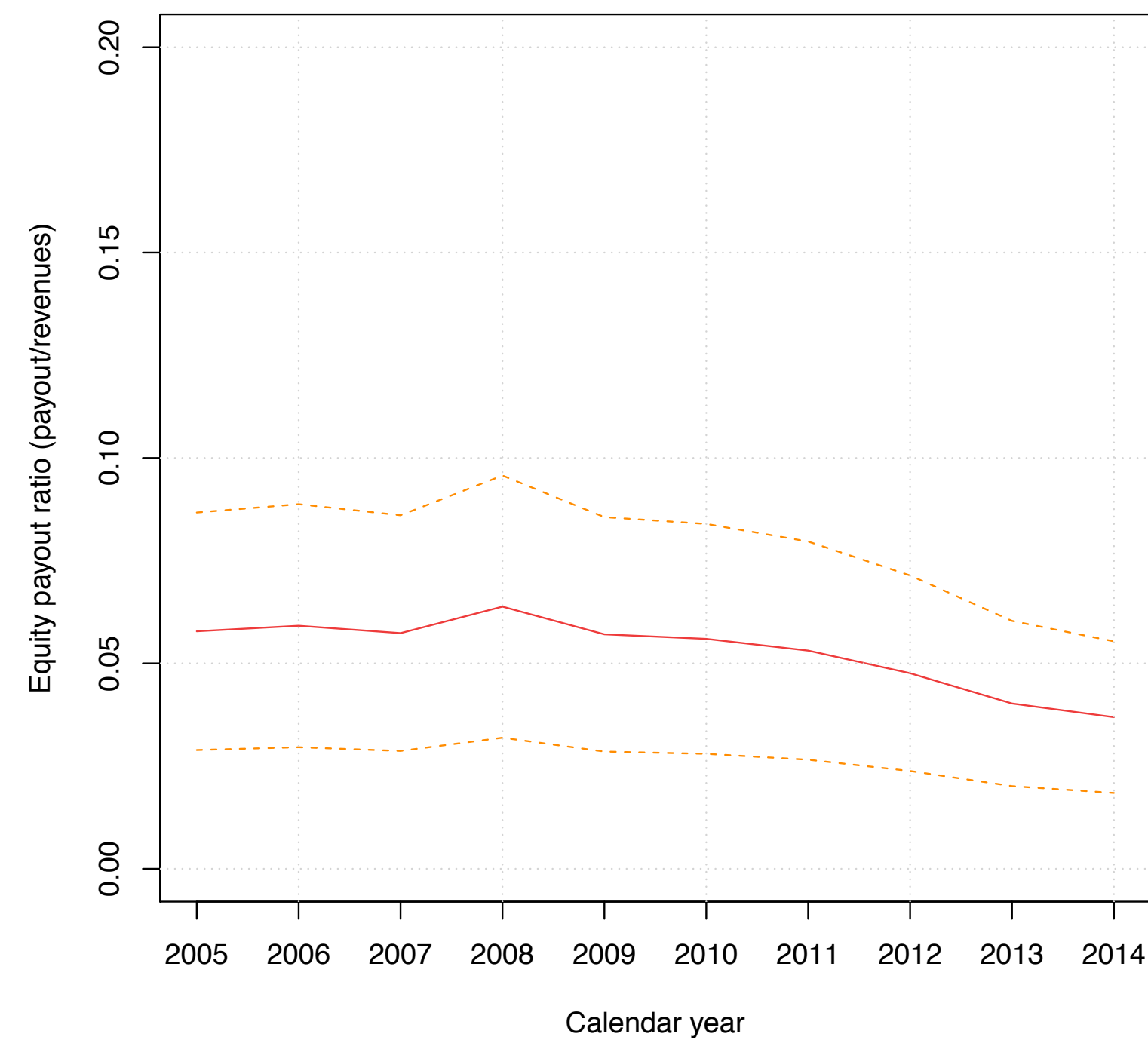
Expected equity payout ratio in public firms matched to contracted infrastructure

Payout ratios a substantially higher for all infra firms relative to all control groups

2.1 Finding infrastructure: do we need a definition?

- Why is there no definition of unlisted infrastructure investment?

- Can we imagine 'fake' infra in the unlisted space?

- Definitions are important
  - Regulation
  - Transparency
  - Potential backlash if 'fake infra' disappoints

2.1 Finding infrastructure: stylised facts (1)

On the nature of the assets

- It's contracts not concrete that matter.

- Real assets? Fundamental differences with real estate include:

  - Infrastructure investments are not a store of value

  - They are the most relationship-specific (size of sunk/stranded costs)
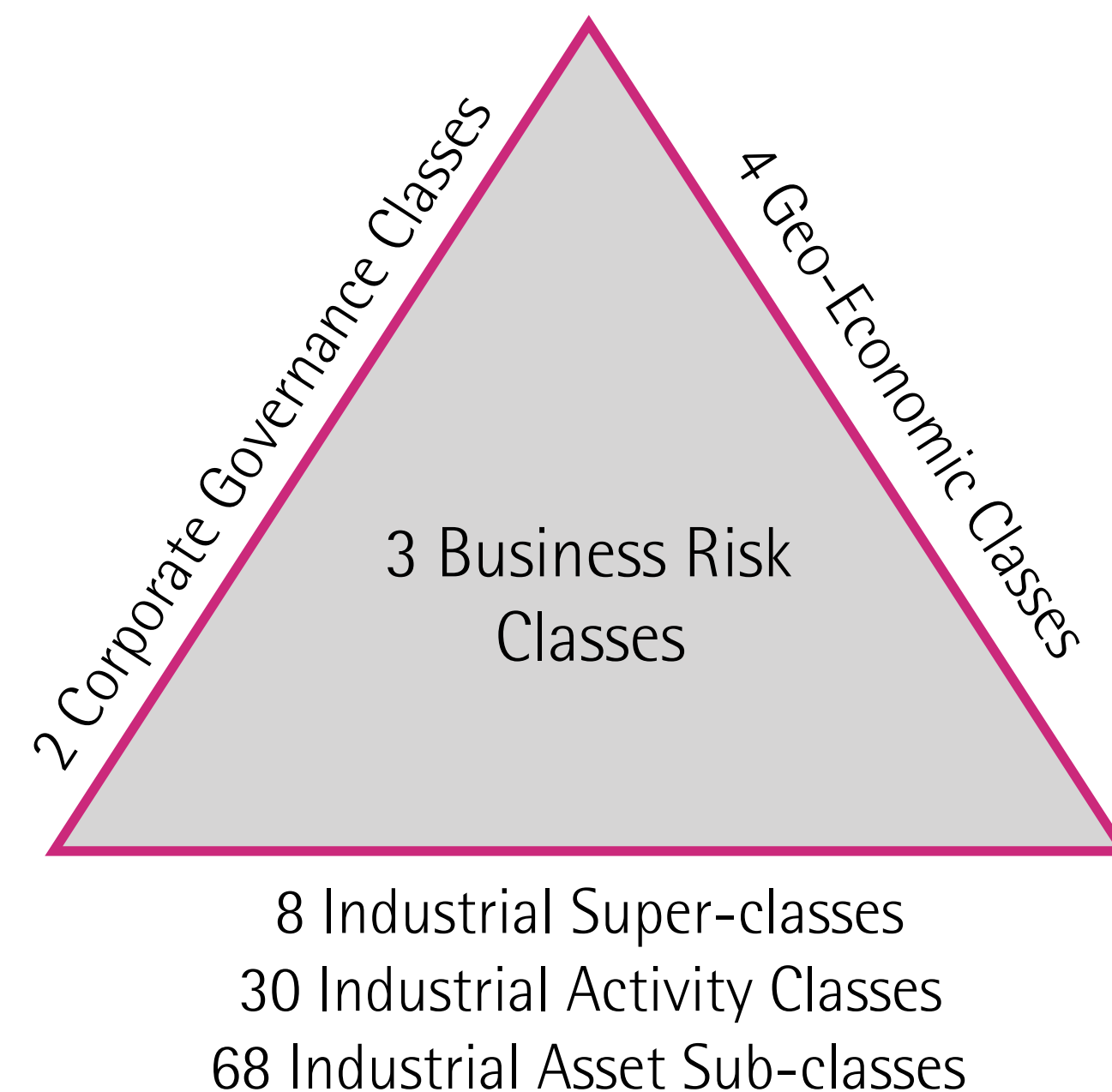
  - Average size is much larger

2.1 Finding infrastructure: stylised facts (2)

On common risk factors found in infrastructure

- **Construction** risk is mostly idiosyncratic in private infrastructure
- **Business models** make all the difference: the distinction between 'contracted', 'merchant' and 'regulated' firms...
  - ... explains difference in credit **spreads**
  - ...explains differences in **DSCR** level and volatility
  - ...explains major differences of **outcome** (profits, payouts, survival)
  - ...explains major differences in the **volatility** of revenues and profits
- The distinction between '**projects**' and '**corporates**' matters: in project finance, *high* leverage signals *low* credit risk

2.2 Finding infrastructure: GICCS (1)

- The Global Infrastructure Companies Classification Standard (GICCS)

- Four-pillar approach focused on risk factors found in infrastructure firms

2 Corporate Governance Classes

4 Geo-Economic Classes

3 Business Risk Classes

8 Industrial Super-classes
30 Industrial Activity Classes
68 Industrial Asset Sub-classes

GLOBAL INFRASTRUCTURE COMPANY CLASSIFICATION STANDARD (*GICCS®*)

EDHEC*infra*
building benchmarks
for infrastructure investors

October 2018

2.2 Finding infrastructure: GICCS (2)

- Standard definitions (OECD, World Bank): public policy focus

- Prudential definitions (EIOPA/Solvency-II, Basel III, CRR-2): risk focus

- GICCS: creates four **taxonomies** to categorise infrastructure firms by
  - Business risk models (contracts)
  - Industrial activities (economics + transactional knowledge)
  - Geo-economic exposures (correlations)
  - Corporate governance forms (monitoring)

- Qualifying under GICCS is one of the criteria to be included in the EDHECinfra broad market indices

II. Measuring Value in Infrastructure investments

3.1 Measuring value in unlisted infrastructure: contingent valuation (1)

- 2017 G20/EDHEC survey question*: "Do you trust the asset valuations reported by infrastructure asset managers?"

- We also asked investors about expected/required returns directly.

- Contingent valuation scenarios for various commun risk factor

"Say that you are offered the opportunity to invest in a Tunnel PPP project in the US. Construction has just been completed. The construction company is now selling its stake in the project. No dividends have been paid out thus far.
- Status: Brownfield
- Business Model: Contracted. Availability payments.
- Concession period: 32 years
- Snr Debt/Equity ratio: 90%

Would you be willing to invest equity in this project at the average expected nominal return (IRR) of ...
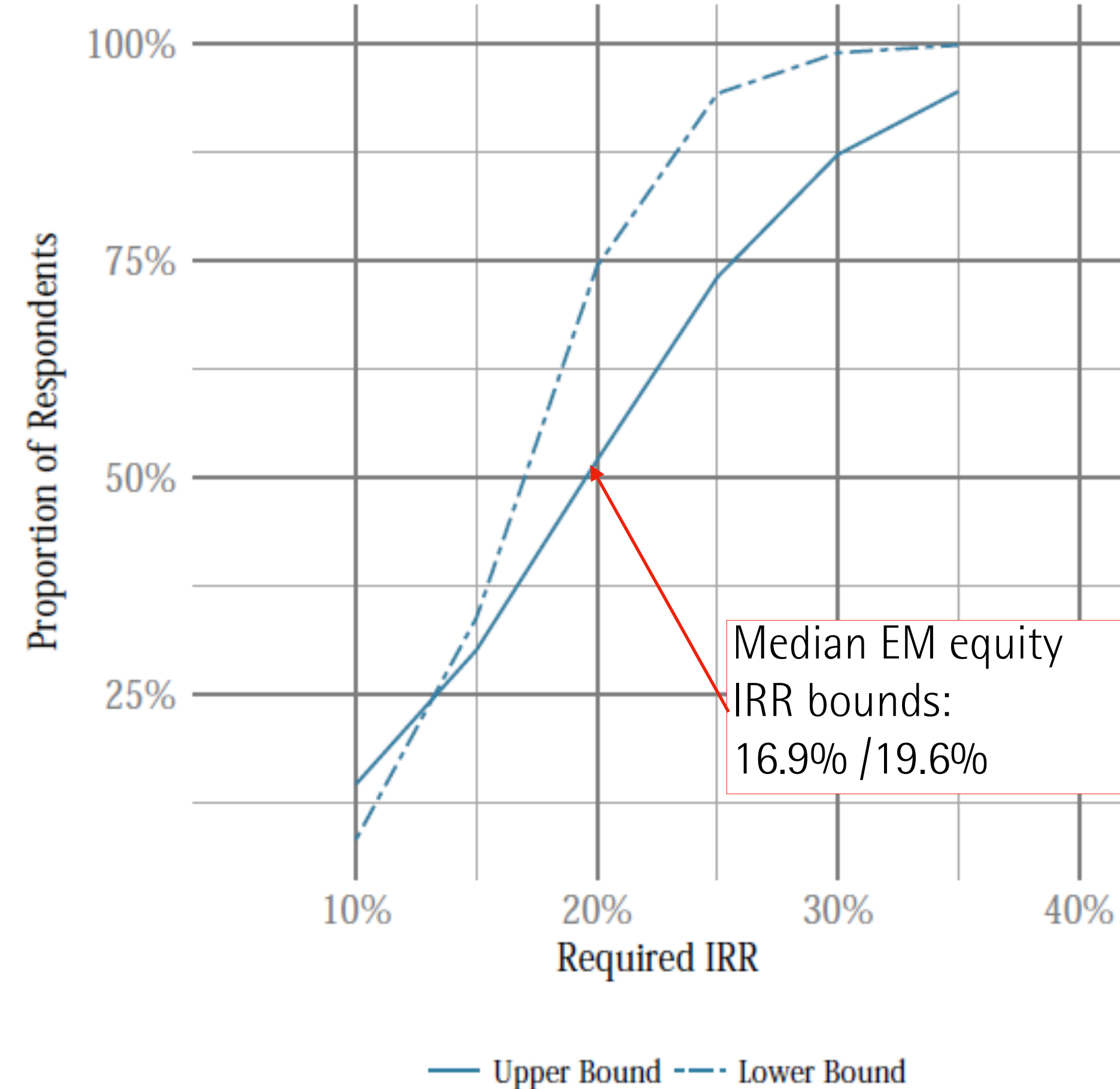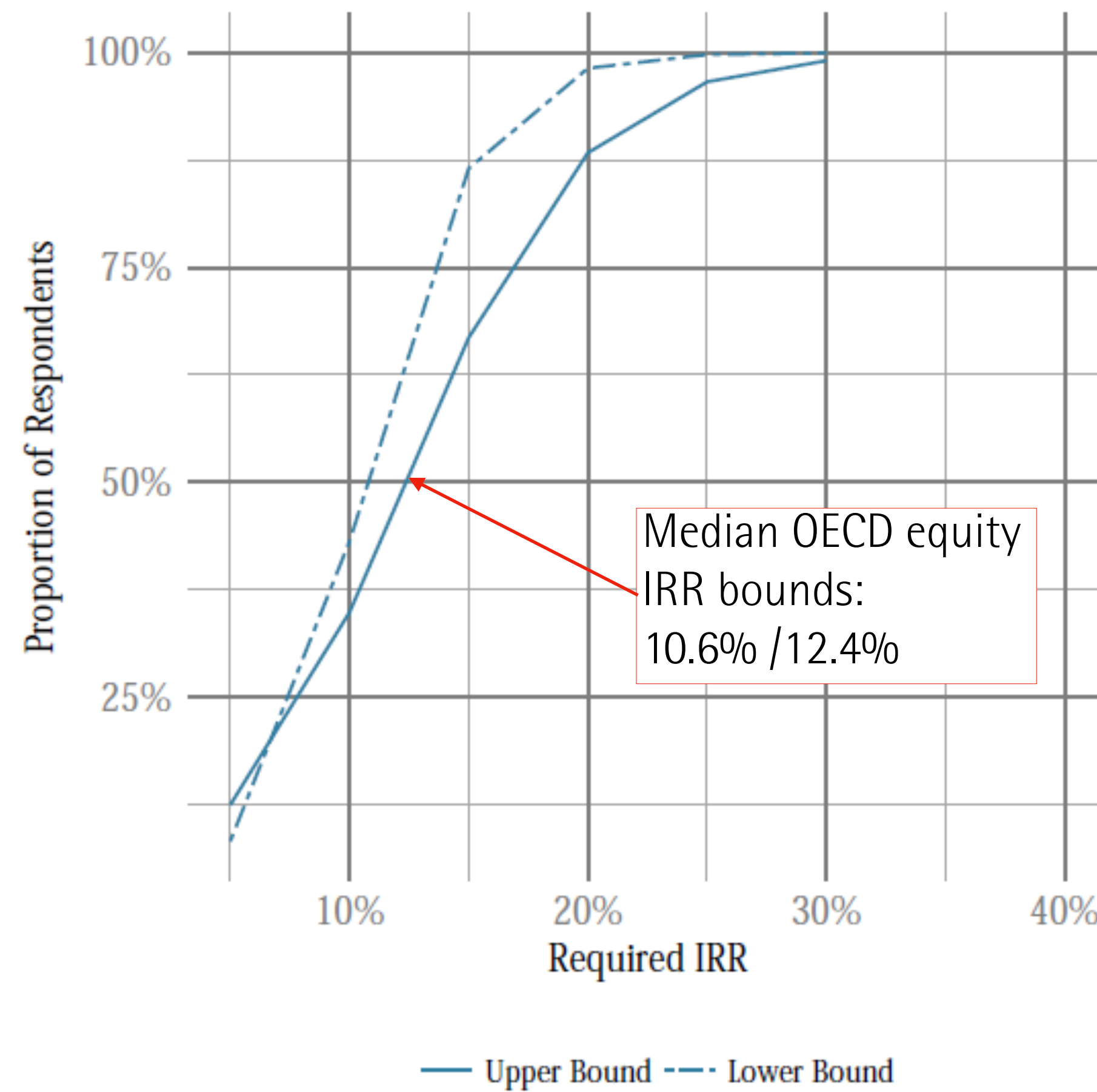
3.1 Measuring value in unlisted infrastructure: contingent valuation (2)

For each scenario, investors must give a range of answers by IRR level:

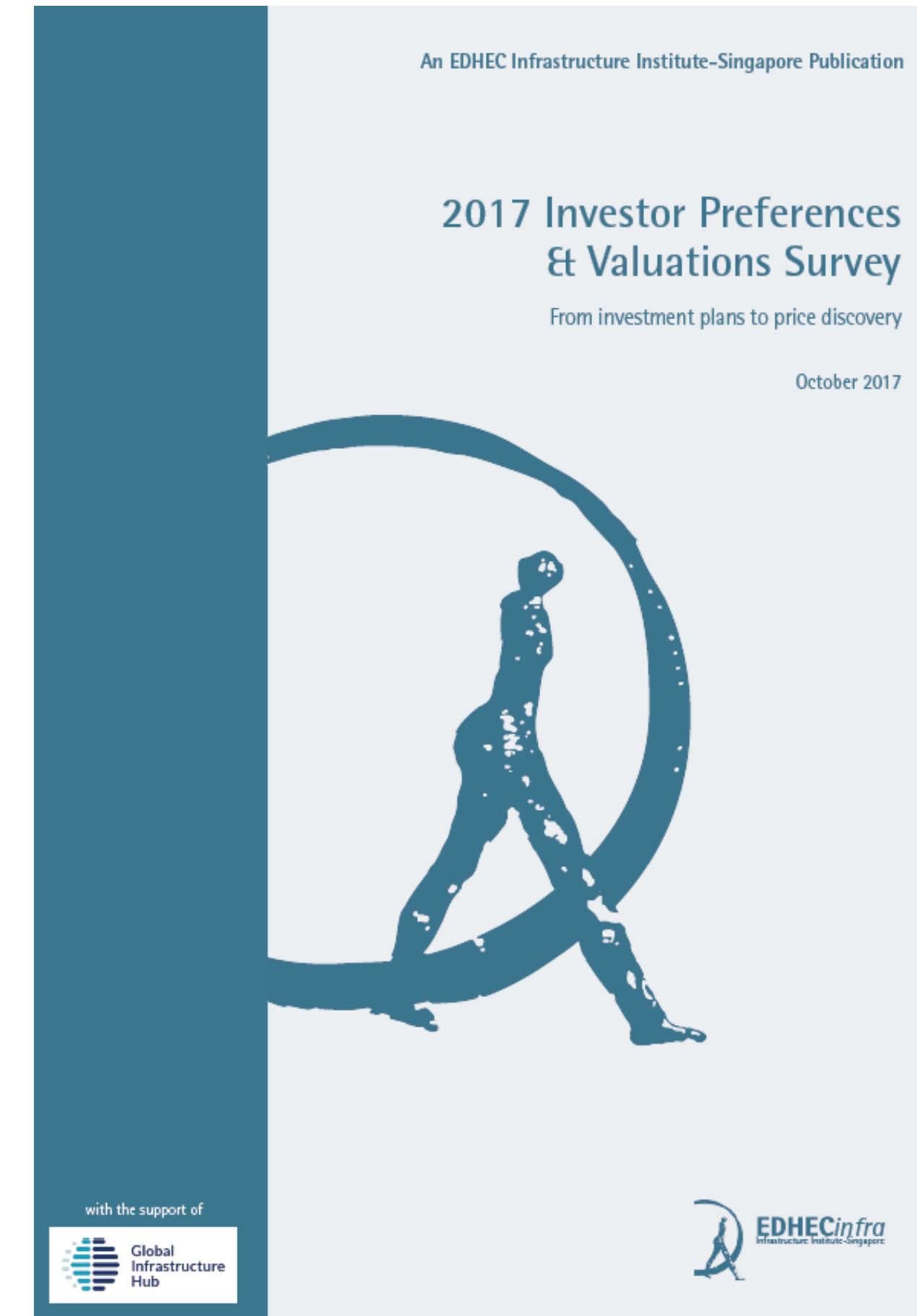|	Definitely "Yes"	Probably "Yes"	Unsure	Probably "No"	Definitely "No"
13%	✓	○	○	○	○
11%	✓	○	○	○	○
9%	○	✓	○	○	○
7%	○	○	✓	○	○
5%	○	○	○	○	✓
3%	○	○	○	○	✓

3.1 Measuring value in unlisted infrastructure: contingent valuation (3)

Willingness to invest in OECD vs Emerging Market infrastructure

Median OECD equity
IRR bounds:
10.6% /12.4%

Median EM equity
IRR bounds:
16.9% /19.6%

— Upper Bound --- Lower Bound

— Upper Bound --- Lower Bound

- There are reasonable **bounds** on value in unlisted infrastructure representing investors' risk preferences: *a bid-ask spread*

- These bounds reflect **systematic risk** factors:

  - Significantly higher returns on merchant infrastructure or emerging markets

  - Questions on greenfield investments did signal higher required returns on average.

  - Sectors made no clear difference either.

An EDHEC Infrastructure Institute–Singapore Publication

2017 Investor Preferences & Valuations Survey

From investment plans to price discovery

October 2017

with the support of
Global Infrastructure Hub

EDHEC*infra*
Infrastructure Institute-Singapore

3.2 Measuring fair value in unlisted infrastructure investments

- Why **fair value**?
  - Fiduciary duty (SAA, monitoring)
  - Asset manager compensation and selection
  - Taking risk into account
  - Regulators have been focusing on inadequate valuation approaches in alternative investment vehicles (US, EU)

- By fair value we really mean as 'mark to market' as possible.

- Which **approach** should we use to measure fair value in unlisted infrastructure?
  - IFRS 13 guidance
  - Industry guidance on private equity
  - Academic literature insights

3.2 Measuring fair value in unlisted infrastructure: first principles

IFRS Fair Value framework

- **Unit of account**: the whole firm
- **Principal market**: active markets where buyers and sellers reveal price preferences (vs. noise) ~ "broad market"
- **Observable inputs**
  - No level-1 inputs (individual assets trading frequently)
  - Level-2 inputs: secondary and primary transactions, market interest and fx rates, survey of investors' "revealed preferences"
  - Level-3 inputs: most available data (accounts, models)
- Choice of valuation **methodology**
  - Primary method: DCF (cf. EDHEC and KPMG surveys)
  - In practice: blend of DCF, comparables and cost methods
- **Calibration** to observable market prices

3.2 Measuring fair value in unlisted infrastructure: the principal market

Our 2018 assessment of the principal market

- National market minimum inclusion criteria (see table)

- 25 countries qualify

- Company-level inclusion criteria
  - Investable i.e. 'available for sale' (IFRS)
  - GICCS qualified
  - Infrastructure revenues
  - Minimum available data (inc. minimum age)

Criteria	Minimum Threshold (on measurement date)		
Size	- Cumulative primary and secondary dealflow since 2000 represents at least 0.5% of the total value of all identified markets AND		
Market Activity	Market turnover ratio* - at least 20% by number of transactions - at least 20% by transaction volume **OR** - The country is part of the European Union[+]		
Financial information	- Availability of basic procurement and financial information including incorporation and financial close dates, book values, etc.		

* ratio of secondary to primary market activity - [+]The European Union is a homogenous procurement market and can be considered a single market in comparison with other part of the global market.

Country	Turnover (number)	Turnover (volume)	Share of Global Dealflow
Australia	39.40%	41.24%	7.05%
Austria	23.81%	29.36%	0.08%
Brazil	6.4%	20%	3.4%
Canada*	55.22%	53.52%	2.74%
Chile	45.83%		1.01%
Germany	31.98%	64.60%	4.05%
Spain	11.08%	26.80%	3.97%
Finland	29.73%	90.85%	0.48%
France	19.69%	68.50%	3.30%
United Kingdom	54.95%	43.89%	11.55%
Hungary*	41.67%	83.64%	0.32%
Ireland	24.04%	32.66%	0.41%
Italy	25.07%	30.23%	2.28%
Malaysia	37.25%	44.11%	1.18%
Netherlands	29.29%	30.93%	1.03%
Norway	65.00%	70.61%	0.24%
New Zealand	125.00%	127.11%	0.22%
Philippines	120.93%	55.01%	0.68%
Poland	29.73%	23.99%	0.64%
Portugal	12.65%	24.59%	1.04%
Russia*	23.81%	11.33%	1.77%
Singapore	54.55%	10.94%	0.44%
Slovakia	62.50%	11.42%	0.15%
Sweden	75.00%	80.90%	0.35%
U.S.A.*	72.32%	57.03%	17.29%

* market to be included in the global EDHEC*infra* Indices in 2019.

3.2 Measuring fair value in unlisted infrastructure: industry guidance

Industry guidance (Int'l Private Equity and VC Association 2015)

- Despite absence of level-1 price information, the objective of the valuation model should be to *mimic would-be market prices*

- Use of DCF recommended for investments that are "similar to debt"

- Controlling for systematic differences in business risk

- Calibrating implied discount rates to current market conditions

- Common aims with **IFRS guidance**:
  - recognition of different levels of valuation inputs
  - appropriateness of different valuation techniques
  - requirement to re-price unlisted assets on a regular basis to reflect the evolution of market conditions at the time of measurement

3.2 Measuring fair value in unlisted infrastructure: industry guidance (2)

- Typical example of the DCF methodology for unlisted infrastructure requires finding the discount rate r to compute

$$NAV = \sum_{t=1}^{\infty} \frac{CF_t}{(1+r)^t} - P_0$$

with P_0 the initial investment, yielding cash flows CF_t in each period t.

- The discount rate r is typically computed as

$$r = R_f + \beta \times ERP + \alpha$$

R_f is the risk-free rate of interest (typically a moving average of short-term rates. 'beta' is the sensitivity of the investment to market risk and ERP the 'equity risk premium' (moving avg of stock market excess returns). 'alpha' is any additional factor e.g. 'liquidity'..

3.2 Measuring fair value in unlisted infrastructure: industry guidance (3)

*What are the **limitations** of this approach?*

1. What is the **correct proxy** of the firm's market beta? Is there one?

2. Moving average risk-free and ERP numbers tend to **smooth** the valuations, and fails to reflect market sentiment

3. **Single factor** model implies that **all risks** found in infrastructure equity can be **proxied by a single** stock market **factor**. This is not robust even for listed equities.

4. Is the the ERP **representative** of the relevant *principal market* for infrastructure investments? Is it the same population expressing risk preferences?

5. Adding *ad hoc* risk premia to account for **illiquidity** is not IFRS 13-compliant... it is too subjective and conflates two things: a liquidity factor loading and liquidity factor price...

3.2 Measuring value in unlisted infrastructure: first principles (8)

Academic insights

- A framework for estimating investors' **expected rates of return** *given common sources of risk* found in financial assets.

- **Expected returns** predicted by *statistically robust* risk factor models provide a basis for the **'fair' discount rate** that should prevail in the principal market.

- The single factor model (CAPM) is *not* robust...

- In the case of listed equities, we use multi-factor models (Fama-McBeth)

  - First determine the **factor loadings** (betas) of each asset over time (regress time series of returns) against pre-identified factors (e.g. size effect, value effect, 'quality' etc.)

  - Then determine the **factor prices** (lambdas) in the cross-section of returns (at each point in time, regress all asset returns against their factor loadings)

- Once both betas and lambdas are known, the expected returns (market-implied discount rate) is simply:

$$E(R_i) - R_f = \lambda_1 \beta_{i,1} + \cdots + \lambda_K \beta_{i,K}$$

3.2 Measuring value in unlisted infrastructure: first principles (8)

In the case of unlisted equity (infrastructure)

- There is no time series of prices revealing factor loadings.

- But we know the loadings of certain factors (the *betas*) on each assets *ex ante*: e.g. size factor, profitability factor, 'merchant' factor, country factors...

- We can also observe some transactions in each period. Given their expected cash flows

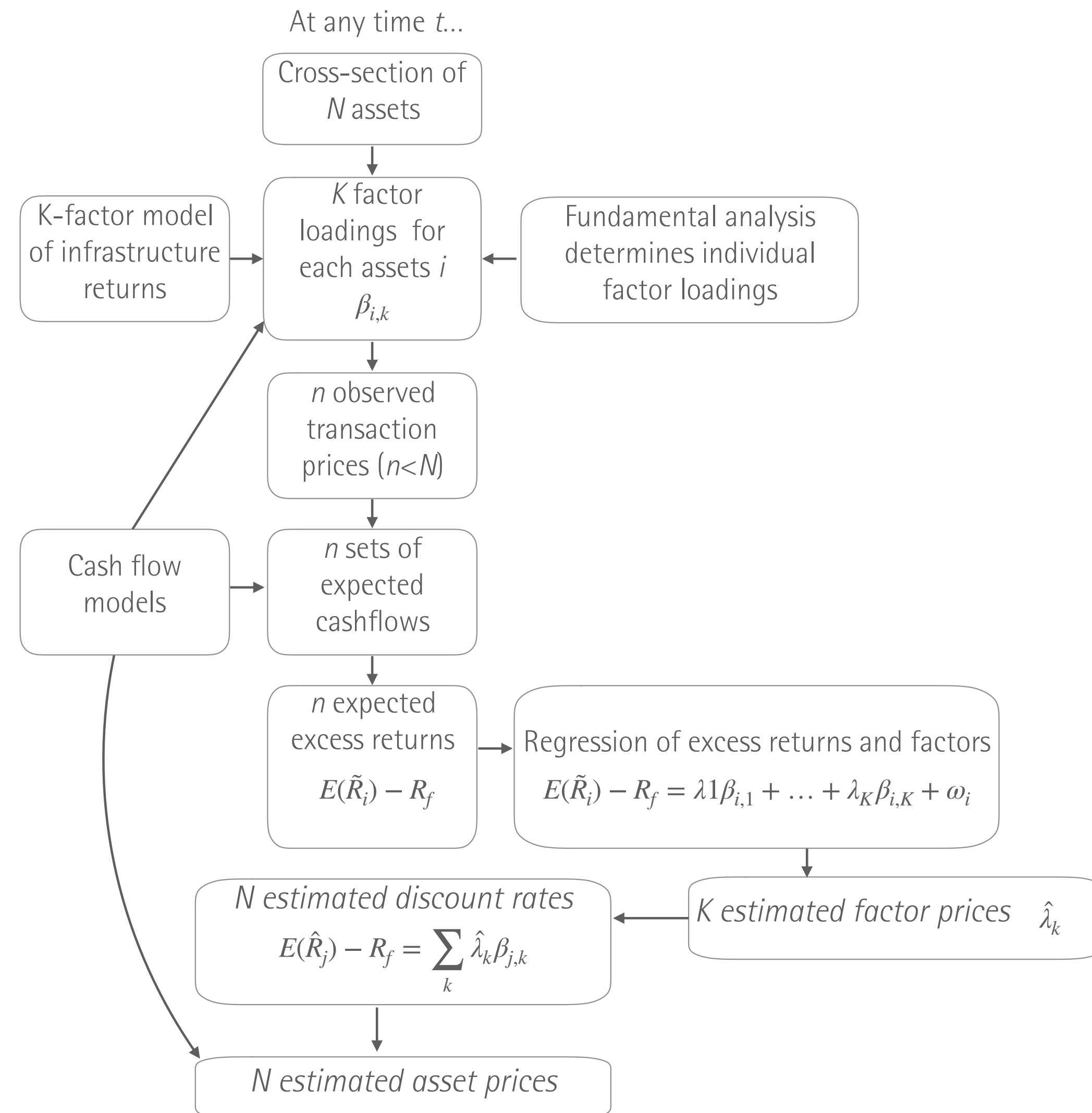$$P_i = \frac{\sum_{t=1}^{T} CF_t}{\left(1 + (R_f + E(\tilde{R}_i))\right)^t}$$

- We can regress the implied excess returns against known factor loadings

$$E(\tilde{R}_i) - R_f = \lambda 1 \beta_{i,1} + \cdots + \lambda_K \beta_{i,K} + \omega_i$$

- This gives us factor prices (the *lambdas*) at that time. We can the apply these factor prices to all assets in the cross section, whether they are traded or not.

- The combination of the betas and estimated lambdas = market discount rate at time t

$$E(\hat{R}_j) - R_f = \sum_{k} \hat{\lambda}_k \beta_{j,k}$$

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At any time t...

Cross-section of N assets

K-factor model of infrastructure returns

K factor loadings for each assets i $\beta_{i,k}$

Fundamental analysis determines individual factor loadings

n observed transaction prices ($n<N$)

Cash flow models

n sets of expected cashflows

n expected excess returns

$E(\tilde{R}_i) - R_f$

Regression of excess returns and factors

$E(\tilde{R}_i) - R_f = \lambda 1\beta_{i,1} + \dots + \lambda_K\beta_{i,K} + \omega_i$

N estimated discount rates

$E(\hat{R}_j) - R_f = \sum_k \hat{\lambda}_k \beta_{j,k}$

K estimated factor prices $\hat{\lambda}_k$

N estimated asset prices

4.1 Empirical application: data collection

- EDHEC*infra* collects data manually for the principal markets identified

- **Investable universe**: each market is studied to determine the investable population (uniquely identified firms)

- **Sampled universe**: A sample of all such markets is created that tracts the investable population over time

- Detailed data is collected for the sampled universe
  - Sources: investors, audited accounts, various sources
  - 650 firms tracked today going back 20 years+
  - 5 millions cash flow and balance sheet items, thousands of attributes, hundreds of events, etc.

4.2 Empirical application: systematic drivers of value (1)

- Implementing our asset pricing approach, we can predict the equity price of unlisted infrastructure companies **whether they trade or not**

  - Factor model uses: size, leverage, profitability, business model, sector effects, country effects, lifecycle effect, corporate governance

  - Absolute median out-of-sample prediction error: 3%

- Examining **price-to-sales ratios**, valuations have increased more rapidly in recent years and imply a significant price premium vs. stocks (median price-to-sales ratio > 3)
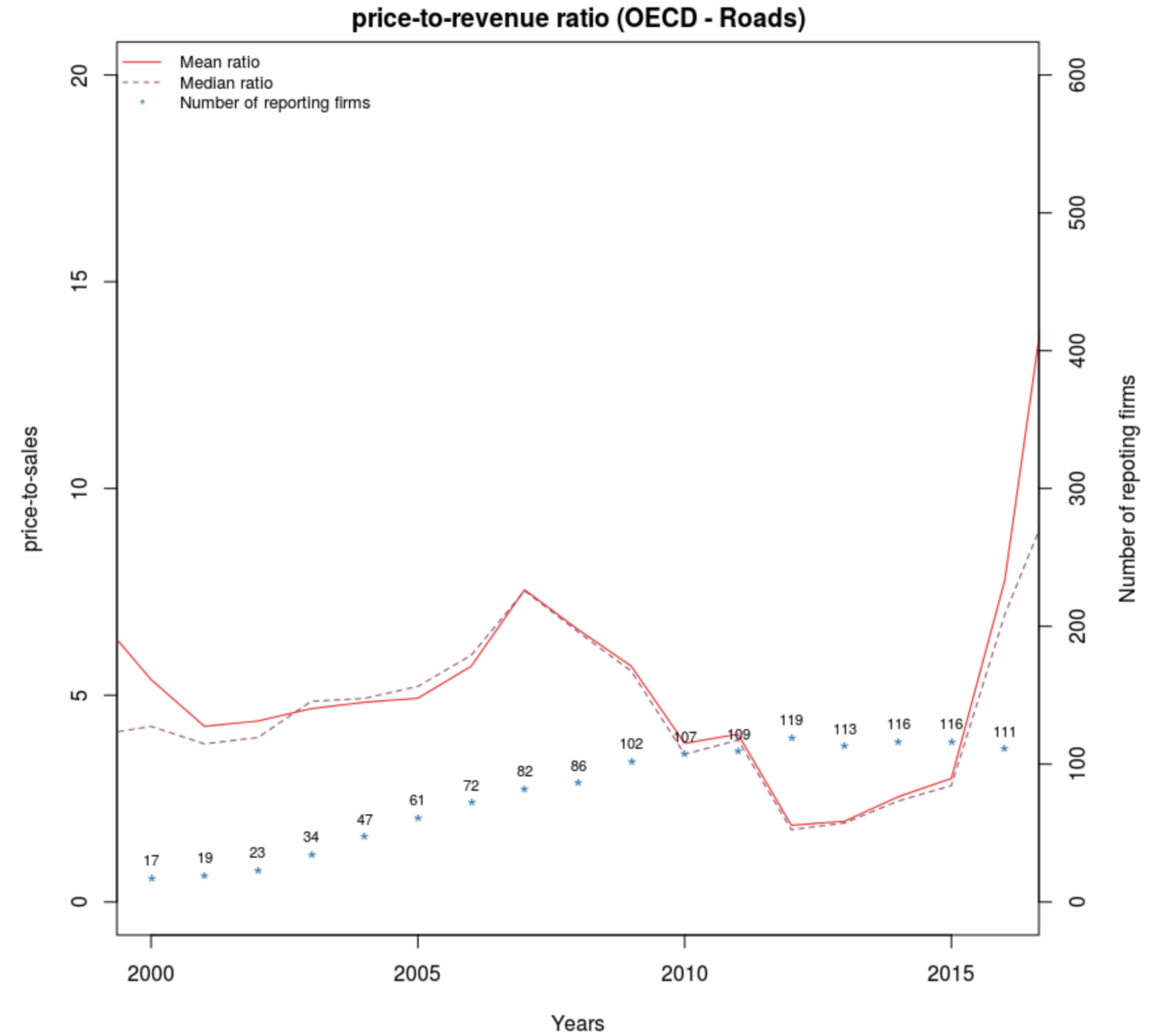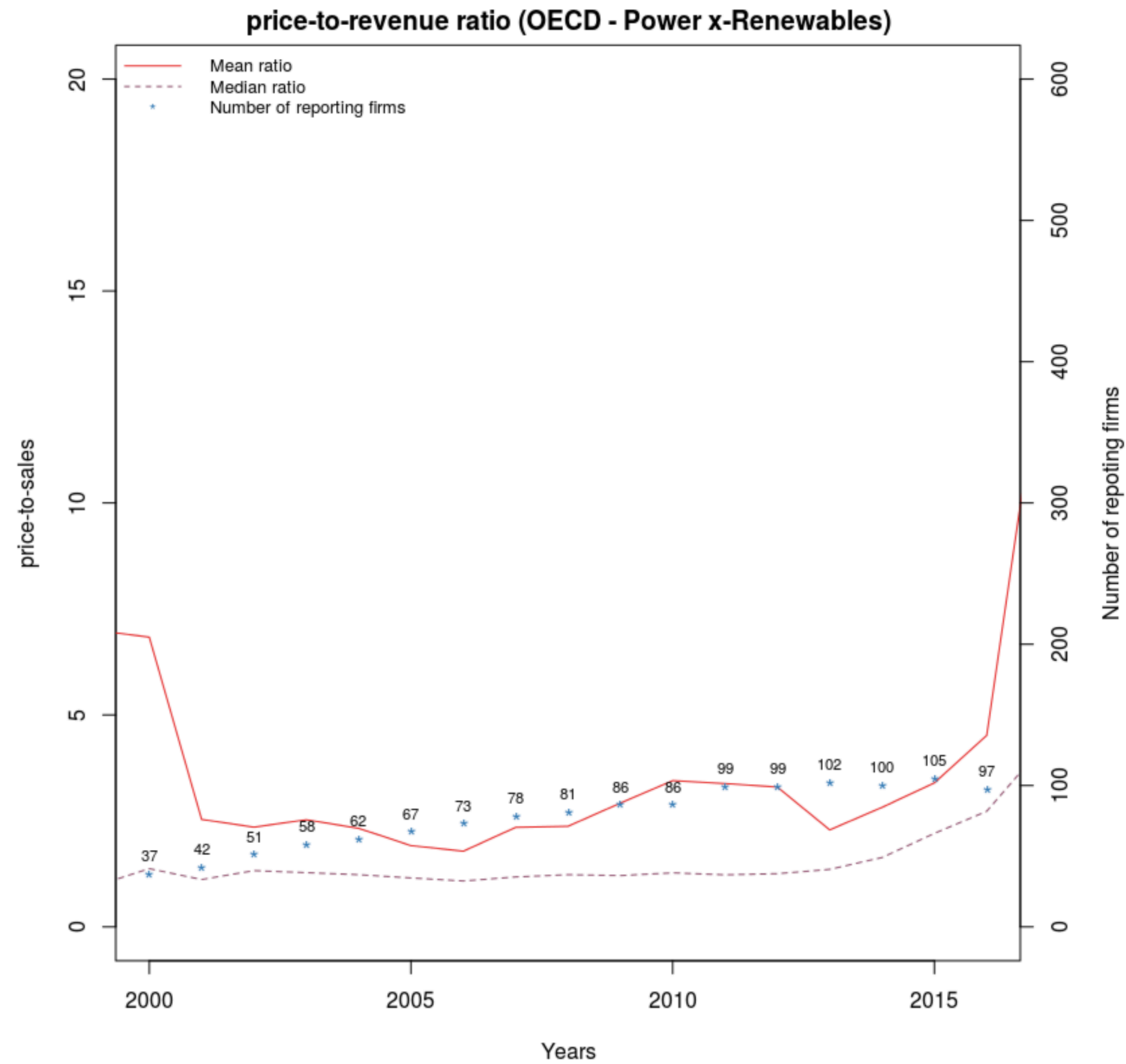
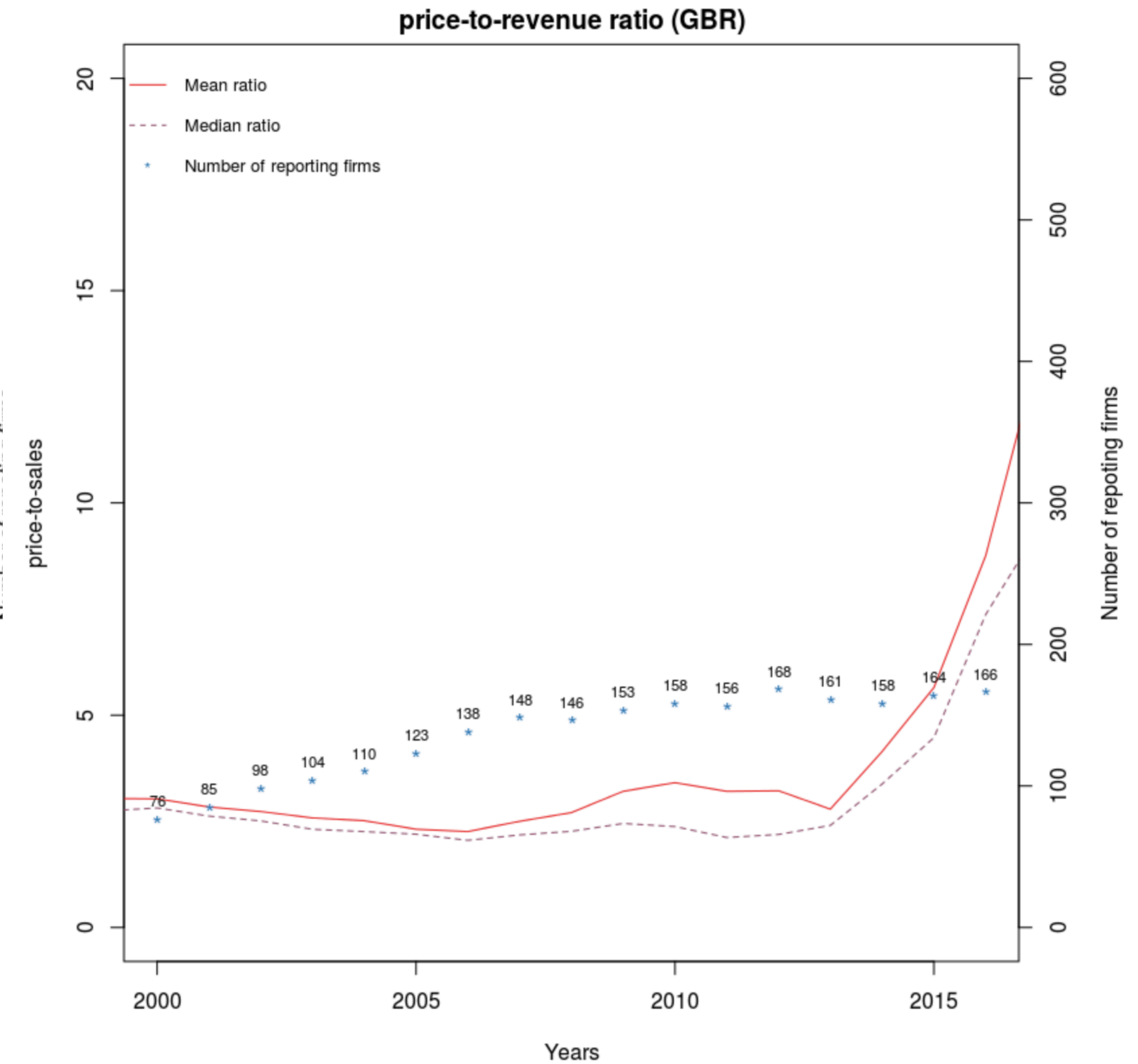# 4.2 Empirical application: systematic drivers of value (2)
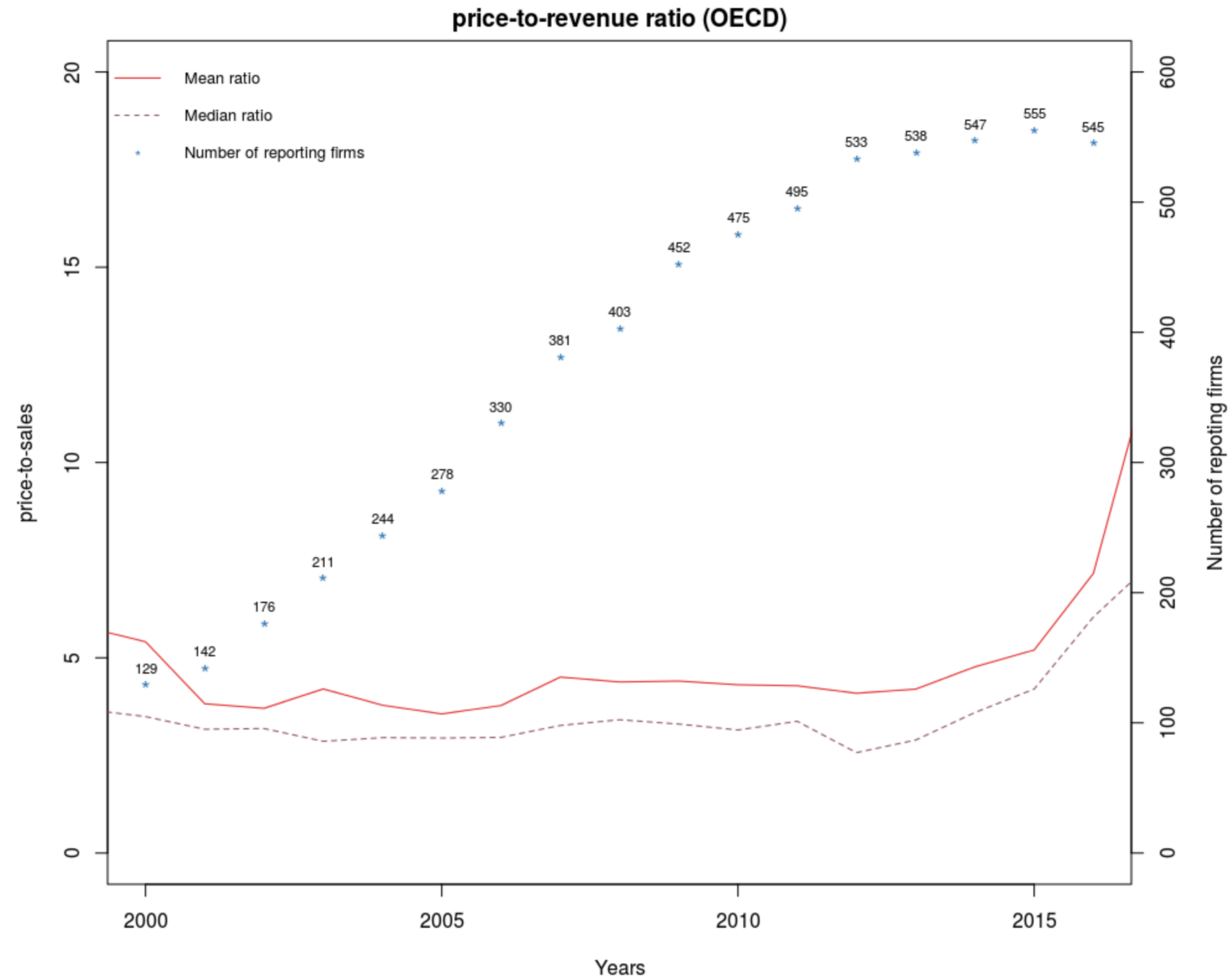
price-to-revenue ratio (OECD)

4.2 Empirical application: systematic drivers of value (3)

price-to-revenue ratio (OECD - Ports)

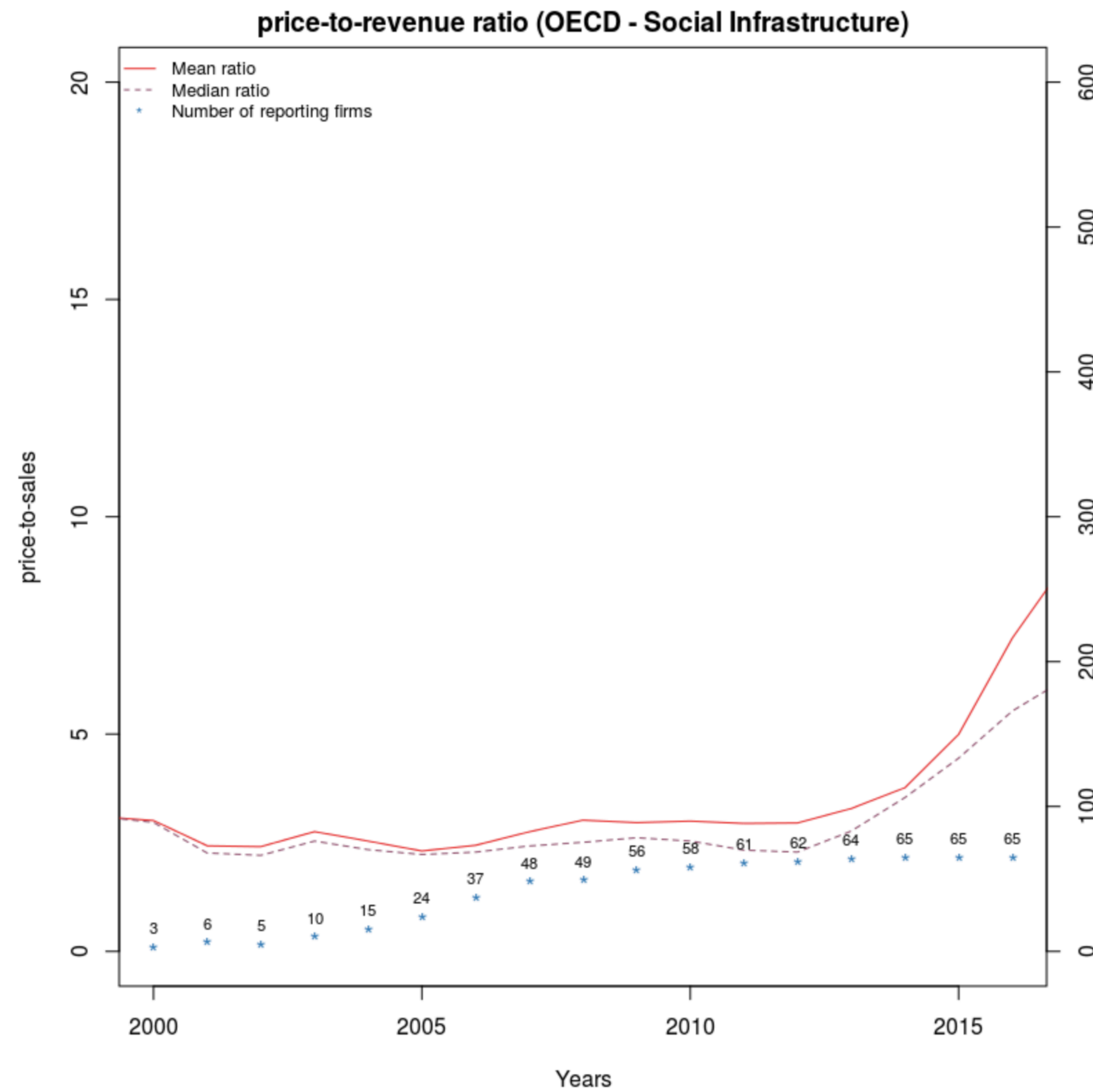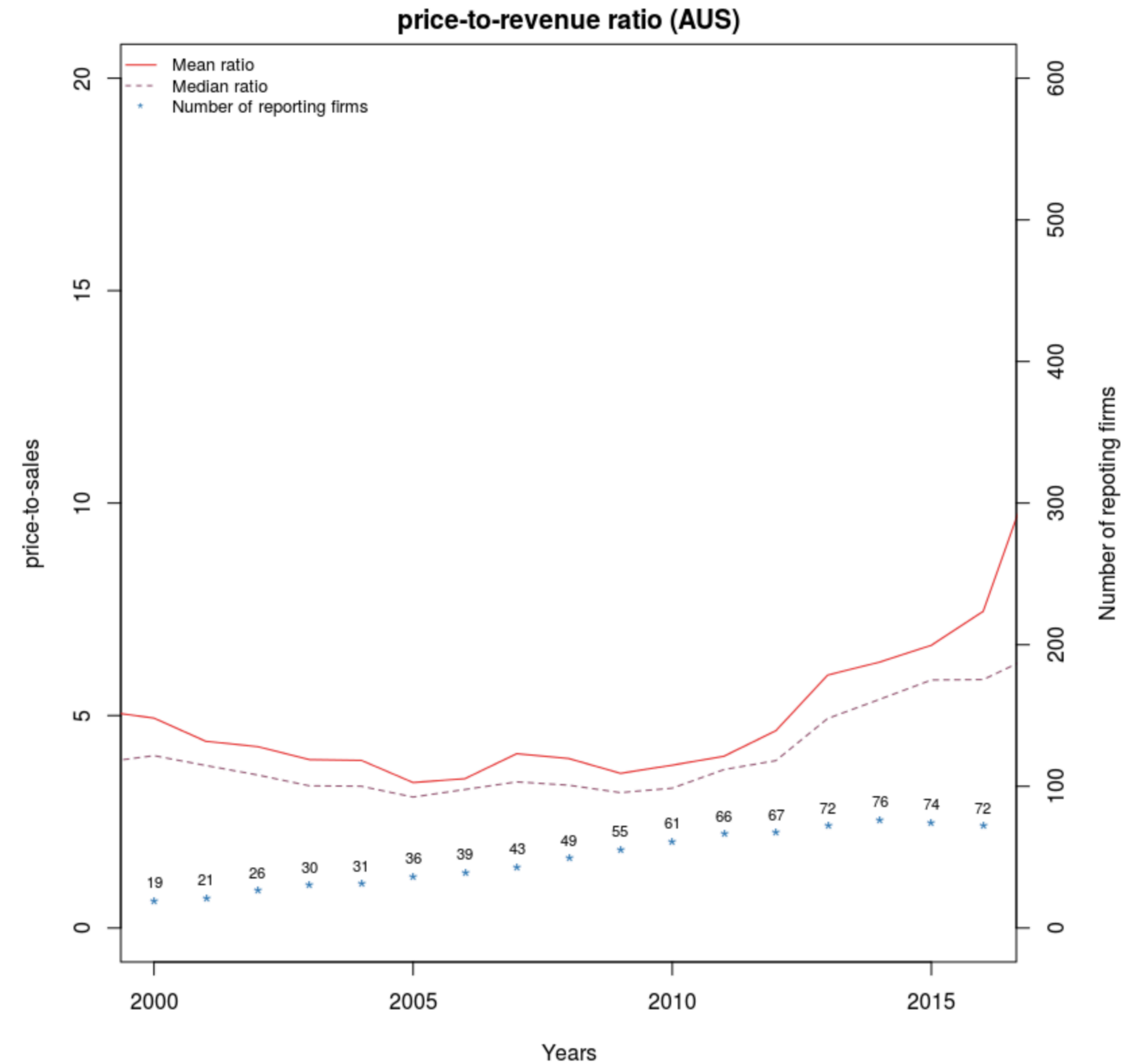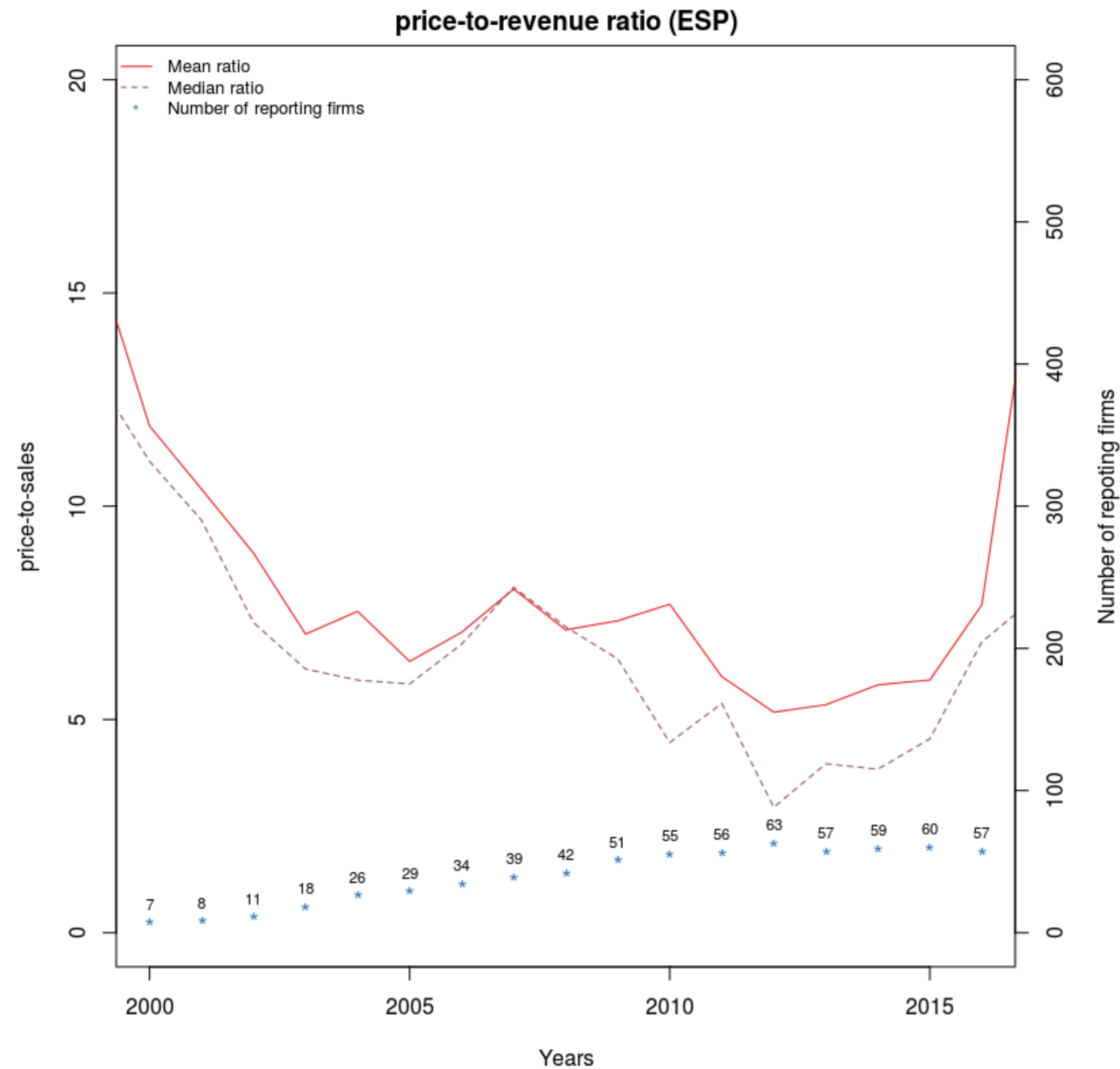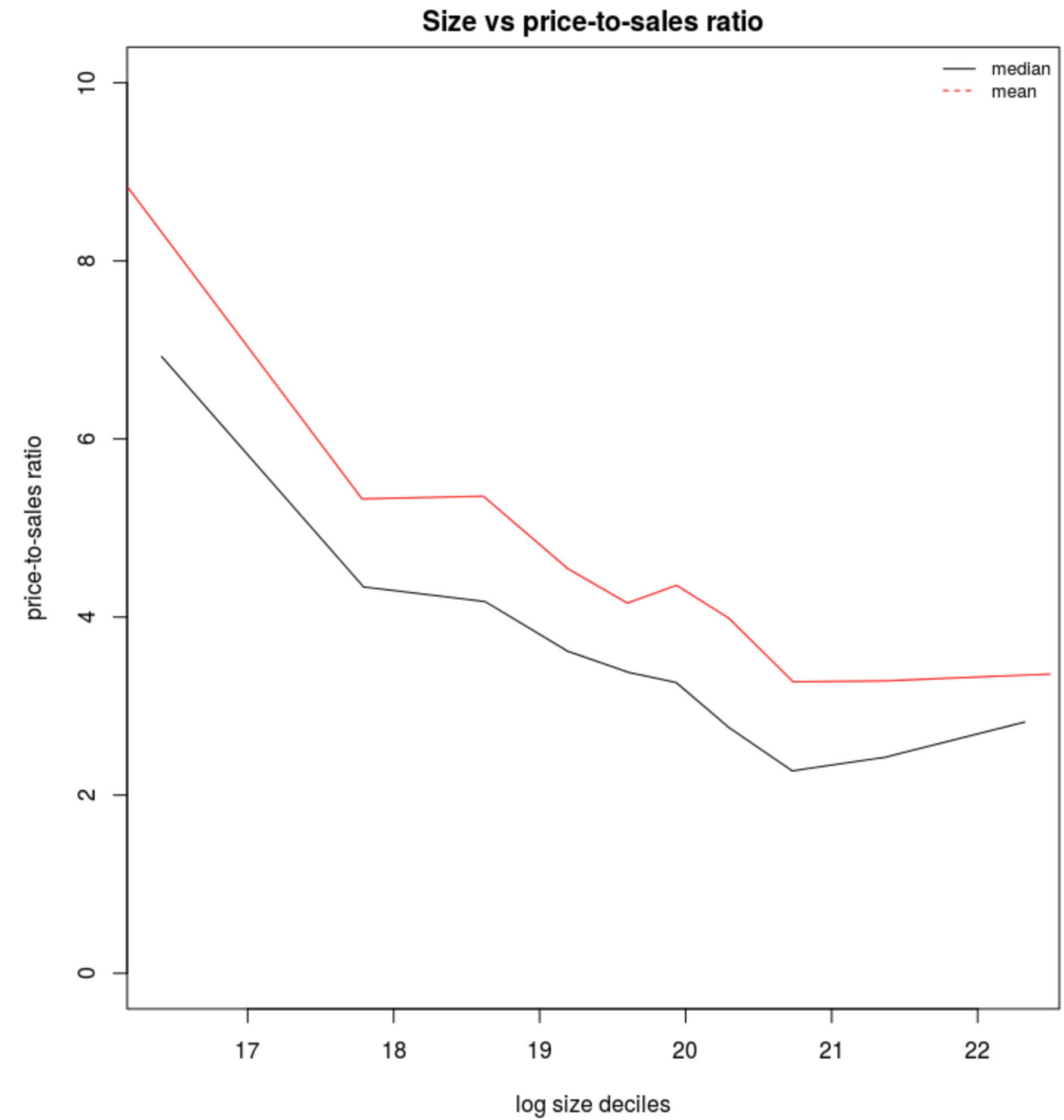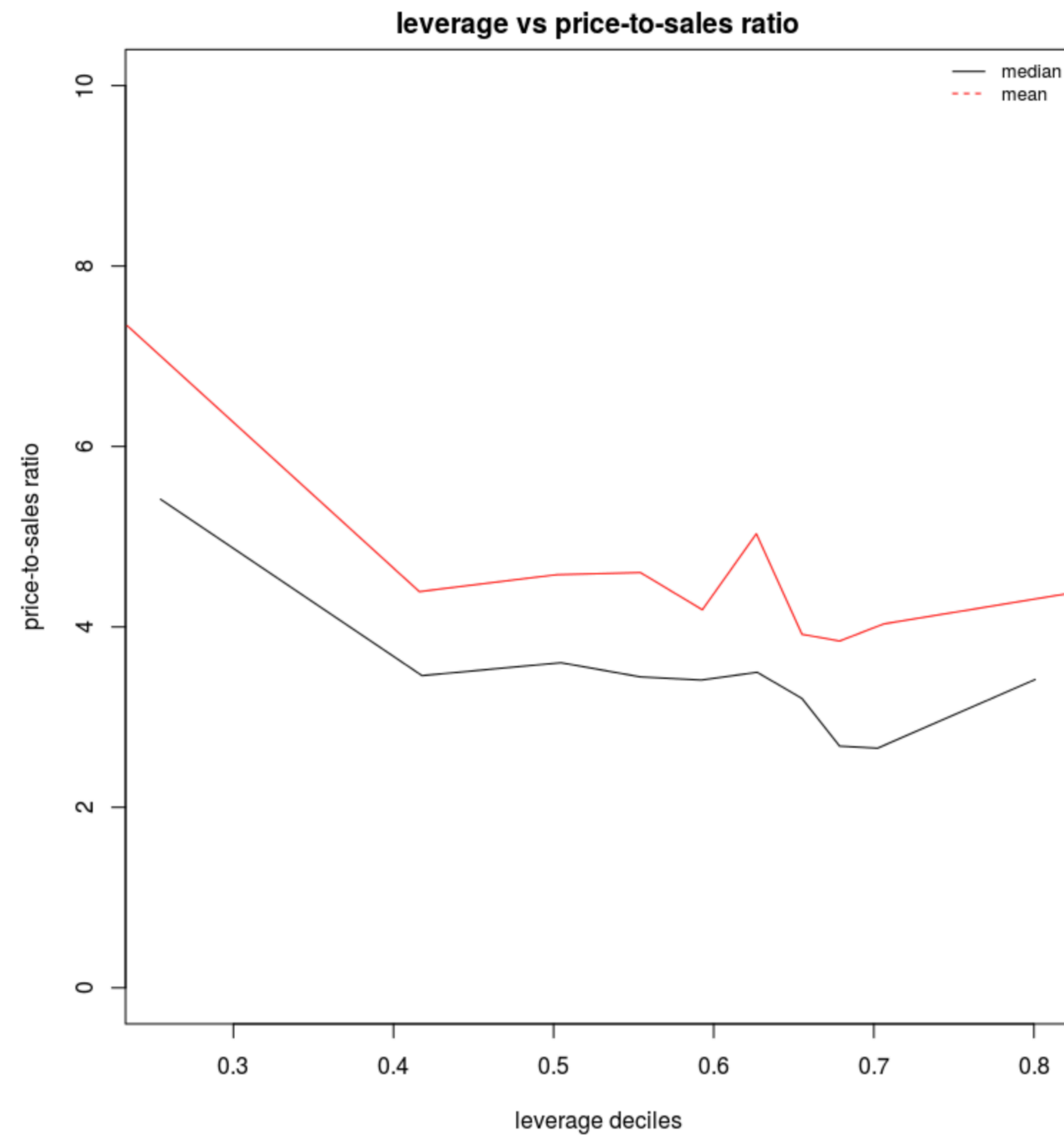price-to-revenue ratio (OECD - Airports)
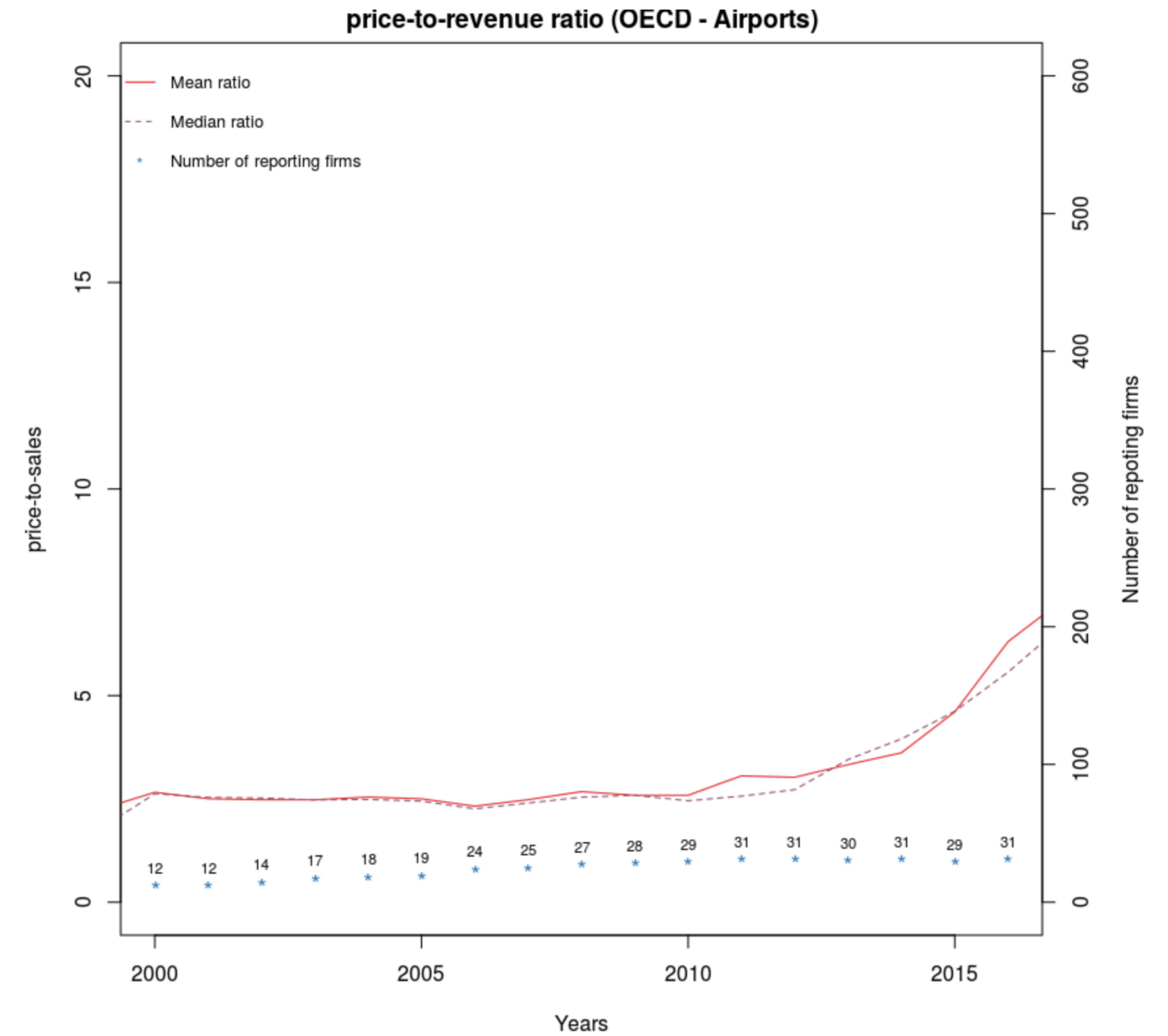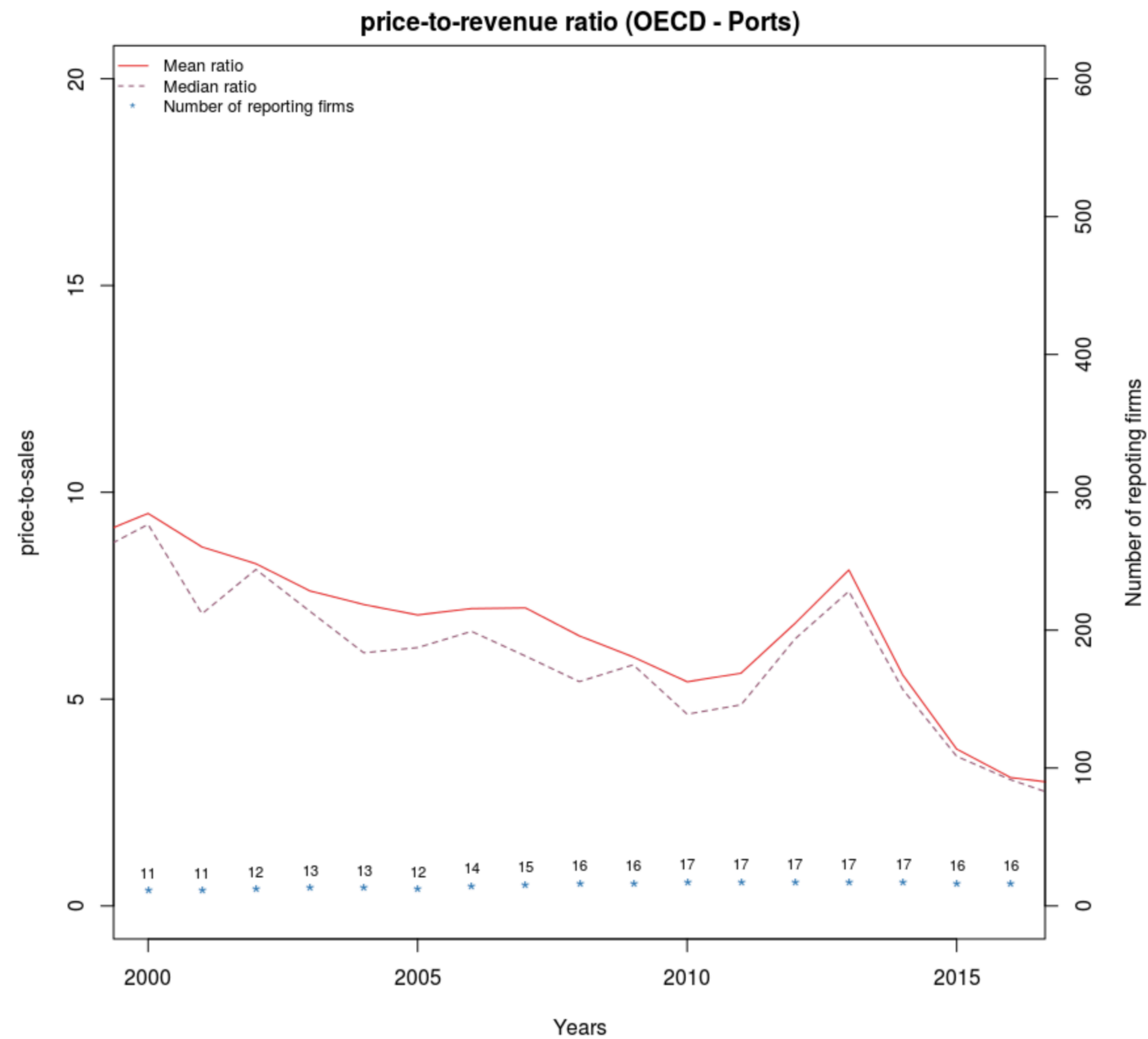
4.2 Empirical application: systematic drivers of value (4)

4.2 Empirical application: systematic drivers of value (5)

4.2 Empirical application: systematic drivers of value (6)

leverage vs price-to-sales ratio

Size vs price-to-sales ratio

4.2 Empirical application: systematic drivers of value (8)

- Using price-to-sales ratios we see that *on average*:

  - **Size** makes a difference smaller firms tend to be more expensive: size partly represents illiquidity and larger assets have higher premia

  - **Leverage** has a u-shape relationship with price

  - **Projects** are more expensive (median pride-to-sales ratio=3.5) than corporates (median=3)

  - **Greenfield** projects do not necessarily have lower prices

  - There are **sector-specific** effects (e.g. UK power, ESP roads) and apparent links with the **business cycle** (e.g. roads, ports) and not all countries are viewed favourably by investors.

4.3 Empirical application: building broad market benchmarks (1)

- Using all available data at each point in time, the **value of individual assets can be measured** while taking into account market preferences

- We can also **measure risk (variance of prices)**: the sum of the volatility of future cash flows and that of each factor price

  - Estimated factor prices (*lambdas*) have an average value (used for valuation) but also a range, given the prices observed in the market at that time (like the bid ask spread of the contingent valuation survey)

- Hence we can measure the variance of prices (and returns) …

- … and their co-variance as well :

$$COV_{n,m} = \sum_{k1,k2=1}^{K} \beta_{n,k1} \omega_{k1,k2} \beta_{m,k2} + \sigma_{n,m}$$

where $COV_{n,m}$ is the covariance of assets n and m

$\beta_{n,k1}$ the exposure of asset n to factor $k1$

$\omega_{k1,k2}$ the covariance of factor $k1$ with factor $k2$

$\sigma_{n,m}$ the specific covariance of assets n and m

Performance, 2005=100

Legend: Market weights · Equal weights · Listed Equities · Listed Infrastructure · IG Corporate bonds

(2)

Index Performance and Risk

	This Quarter	Annualised	1-year	3-year	5-year	10-year	Historical
Total Returns	2.47%	10.23%	10.11%	10.03%	10.36%	11.84%	11.89%
Spreads (excess ret.)	2.1%	8.68%	8.77%	8.53%	8.74%	9.47%	8.74%
Volatility	8.088%	16.177%	16.248%	15.6%	14.691%	18.063%	16.644%
Sharpe Ratio	0.26	0.536	0.54	0.547	0.595	0.524	0.525

Total returns include returns from payouts; excess returns are the difference between total returns and the relevant risk-free rates; reported volatility is the index risk measure and incldues the impact of return covariance; Sharpe ratios are the ratio of exess returns to index volatility.

4.3 Empirical application: building broad market benchmarks (2)

Broad market indices (equal and value weights) vs. listed equities ('infra') and IG bonds
All indices in local currency returns

	3-year	5-year	10-year	Historical
EDHEC*infra* Infra Broad Market: global, equal-weighted, fully hedged				
Return	12.91 %	13.04 %	13.98 %	13.58 %
Volatility	10.39 %	9.99 %	10.55 %	10.26 %
Sharpe ratio	1.101	1.148	1.108	1.021
EDHEC*infra* Infra Broad Market: global, value-weighted, fully hedged				
Return	10.03 %	10.36 %	11.84 %	11.89 %
Volatility	15.60 %	14.69 %	18.06 %	16.64 %
Sharpe ratio	0.547	0.595	0.524	0.525
Listed infra: Dow Jones Brookfield Global Infrastructure Index (DJBGILC)				
Return	3.57 %	8.70 %	6.76 %	9.58 %
Volatility	9.98 %	10.76 %	17.54 %	16.56 %
Sharpe ratio	0.19	0.66	0.24	0.42
IG corporate bonds: Bank Of America Merrill Lynch Global Broad Corporate Index (MLGCORL)				
Return	3.56 %	3.95 %	5.07 %	5.02 %
Volatility	2.73 %	2.92 %	5.55 %	4.81 %
Sharpe ratio	0.95	0.98	0.54	0.49

4.3 Empirical application: building broad market benchmarks (3)

Comparing portfolios of infra projects vs infra corporates (equal weights, local currency returns)

|	3-year	5-year	10-year	Historical
EDHEC*infra* Infra Project: global, equal-weighted, fully hedged				
Total Return	13.14 %	13.26 %	14.04 %	13.81 %
Volatility	**9.88 %**	**10.70 %**	**10.50 %**	**10.47 %**
Sharpe ratio	**1.075**	**1.099**	**1.104**	**1.017**
EDHEC*infra* Infra Corporates: global, equal-weighted, fully hedged				
Return	12.29 %	12.46 %	13.78 %	13.21 %
Volatility	**12.61 %**	**11.45 %**	**13.26 %**	**16.52 %**
Sharpe ratio	**0.894**	**0.987**	**0.891**	**0.620**
EDHEC*infra* Broad Market: global, equal-weighted, fully hedged				
Return	12.91 %	13.04 %	13.98 %	13.58 %
Volatility	**10.39 %**	**9.99 %**	**10.55 %**	**10.26 %**
Sharpe ratio	**1.101**	**1.148**	**1.108**	**1.021**

Infrastructure projects have higher returns and lower volatility than infrastructure corporates

# 4.3 Empirical application: building broad market benchmarks (4)

Implications of main findings so far

- Unlisted infrastructure equity **differs from listed** infrastructure/ equities

- Price movements and index vol suggest that it is **not without risks**

- But risk levels are lower than listed equities and **risk-reward trade-offs more in line with IG bonds** at the index level

- **Diversification** matters but is *hard to achieve* (high idiosyncratic vol means that many assets are needed to achieve 'enough' diversification)

- Infrastructure companies can be **grouped into different risk profiles**: these can make useful portfolio building blocks or individual strategies

Launching soon: an index data & analytics platform
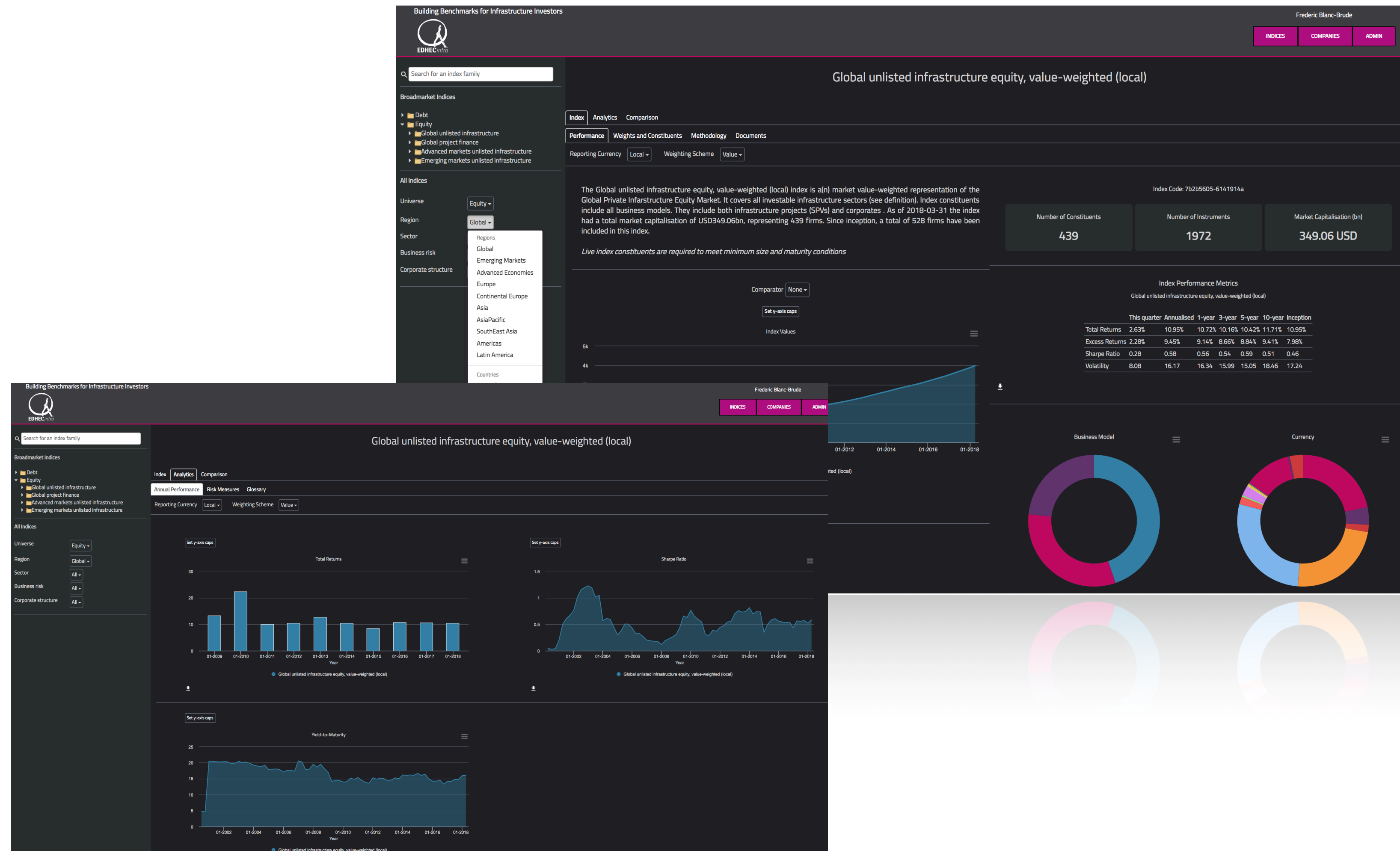
EDHECinfra Indices Documentation
(updated versions available in November 2018)
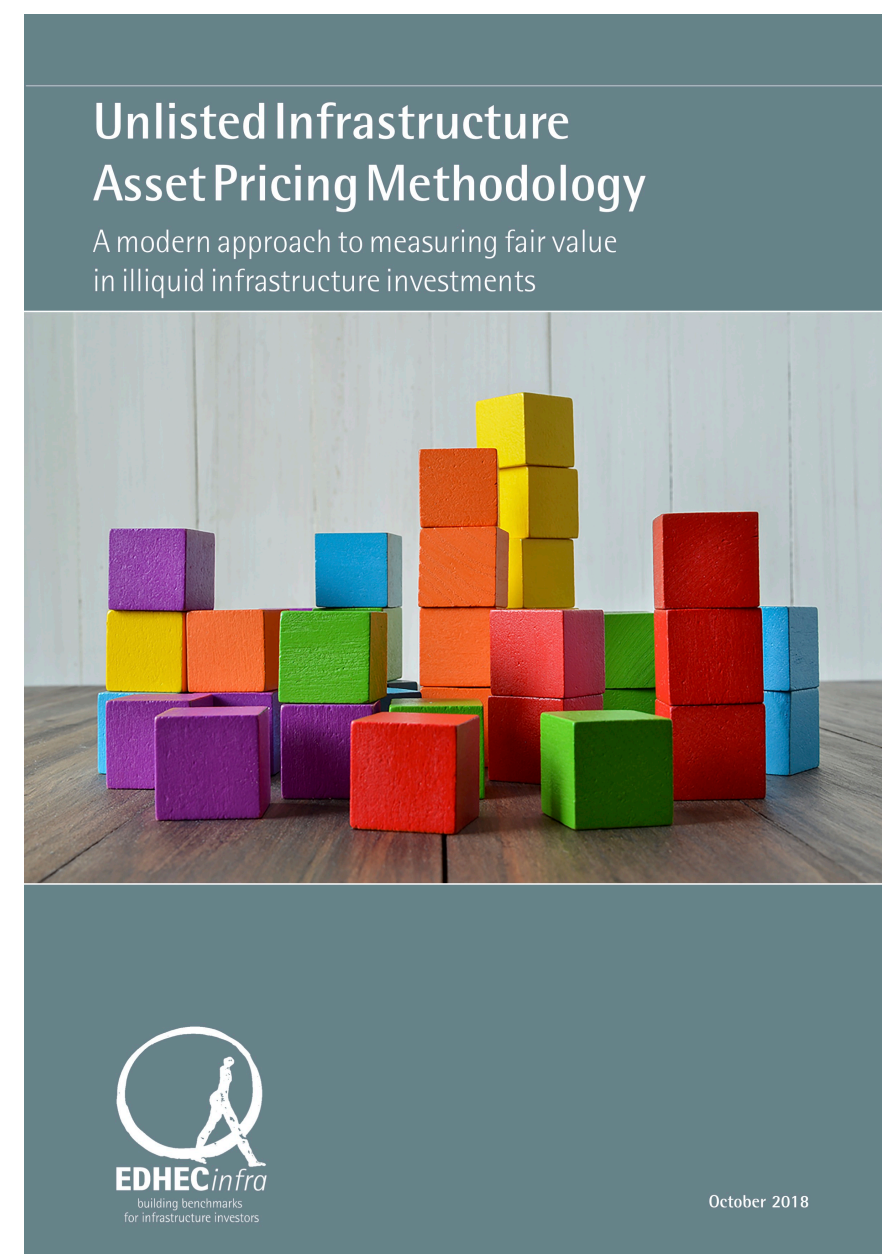
5. Conclusion

Infrastructure is a changing asset class.

A better understanding and more data and transparency can transform the sector and what it has to offer to investors.

Or not...